THE OHIO
JOURNAL OF SCIENCE

VOLUME XLIX—1949

GLENN W BLAYDES Editor-in-Chief

PUBLISHED AT COLUMBUS, OHIO BY THE
OHIO STATE UNIVERSITY
and the
OHIO ACADEMY OF SCIENCE

THE OHIO JOURNAL OF SCIENCE

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THE OHIO JOURNAL OF SCIENCE

Is published jointly by the Ohio State University and the Ohio Academy of Science

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PUBLICATION DATES
of
The Ohio Journal of Science

Volume XLIX 1949

January issue	February 28 1949
March issue	May 5 1949
May issue	July 10 1949
July issue	August 9 1949
September issue	November 22 1949
November issue	December 23 1949

THE OHIO JOURNAL OF SCIENCE

VOL XLIX JANUARY, 1949 No 1

AN ADDITIONAL FOSSILIFEROUS MEMBER IN THE ALLEGHENY FORMATION (PENNSYLVANIAN) OF OHIO[1]

MYRON T STURGEON AND WILLIAM M MERRILL[2]
Ohio University and The Ohio State University

INTRODUCTION

In eastern Ohio stratigraphic members of marine and brackish water origin are present in the Pottsville, Allegheny, and Conemaugh formations or series of the Pennsylvanian system None is known in the overlying Monongahela formation, and only one brackish member occurs in the still higher Dunkard series of Permian age In our Pennsylvanian, the marine and brackish members characteristically overlie a coal in the normal stratigraphic succession although many coals lack such overlying members Coal and a marine and/or brackish water unit, together with other lithologic types, occur in a definite stratigraphic succession called a cyclothem by Weller (1932, footnote, p 1003, *Correlation and Extent of Pennsylvanian Cyclothems* by H R Wanless and J M Weller See also Weller, 1930, 1931, for further descriptive details) Many cyclothems occur above one another in the Pennsylvanian system of eastern and central North America, and a complete cyclothem has the following sequence of beds (See also Wanless, 1939, p 8)

MARINE
- 9 Shale containing clay ironstone bands and thin limestones
- 8 Limestone
- 7 Calcareous shale
- 6 Black shale

CONTINENTAL
- 5 Coal
- 4 Underclay
- 3 Limestone
- 2 Sandy and micaceous shale
- 1 Sandstone
- Disconformity

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[1] Published by permission of the State Geologist of Ohio, Columbus, Ohio

[2] We are indebted to a number of persons for aid and encouragement during the preparation of this paper Mr John H Melvin, State Geologist of Ohio has been especially helpful to us during the study of the Dorr Run shale Messrs Merrill F Aukland, Gerald L Bell, and William H Smith have rendered services in the field that facilitated our studies Dr Norman D Newell, Department of Geology, Columbia University, New York City, and Dr Walter Youngquist, Department of Geology, University of Idaho, Moscow, Idaho, have given special aid in the identification of fossil pelecypods and conodonts, respectively The Geological Survey of Ohio has provided the services of Miss L Beatrice Pugsley for drawing the stratigraphic sections and index map Mr W C Heilman took the pictures shown in Figs 1-3 Carolyn Sturgeon, wife of the senior author, has assisted in the typing of the manuscript A grant from The Ohio University Fund, Inc , has defrayed the photographic expenses and costs of printing the illustrations We are indeed happy to acknowledge and to express our appreciation for all assistance and services given by the above persons and organizations

In Ohio only two cyclothems, one associated with the Middle Kittanning coal in the Allegheny formation and another associated with the Anderson coal in the Conemaugh formation (Stout, 1939, 1947), are recognized as more or less complete Inspection of Stout's stratigraphic charts shows that all other Ohio cyclothems are incomplete and that several may consist of as few as two members, although Stout and Lamborn (1924, pp 238, 258, and 262) cite the occurrence of fossils in shale above the Upper Freeport coal in Center and Madison townships, Columbiana County, Ohio

In the Allegheny formation five marine members are known to be present, and in ascending order these are the Putnam Hill limestone, Zaleski flint, Vanport limestone and flint, Hamden limestone and shale, and Washingtonville shale The stratigraphic position of these members and their relationship to the other members of the cyclothem especially the underlying coals are shown in the following chart of the Allegheny formation which is modified from Stout (1947)[3]

		THICKNESS	
MEMBER	LITHOLOGY	Ft	In
Upper Freeport, No 7	Coal, patchy	3	0
	Clay and shale	7	0
Upper Freeport	Limestone and marly shale	2	0
Bolivar	Coal, local, thin	0	3
Bolivar	Clay, flint and plastic	5	0
Upper Freeport	Shale or sandstone	33	0
Lower Freeport or Rogers	Coal, patchy	1	0
	Clay, impure	2	6
Lower Freeport	Limestone, local	1	0
Lower Freeport	Shale or sandstone	25	0
Upper Kittanning	Coal, local	1	0
	Shale and sandstone	10	0
Washingtonville	Shale marine	4	0
Middle Kittanning No 6	Coal, persistent	4	0
	Clay, siliceous	3	6
Salem	Limestone, impure local	0	6
	Shale with red kidney ore	10	0
Strasburg	Coal, local	0	6
Oak Hill	Clay, flint and plastic	4	0
	Shale siliceous	3	0
Hamden	Limestone, unsteady, marine	4	0
Lower Kittanning No 5	Coal	2	4
	Clay, plastic	5	0
Lawrence	Coal, shaly, local	0	4
	Clay, flint and plastic	6	0
Kittanning	Shale and sandstone	8	2
Ferriferous	Ore, irregular	0	8
Vanport	Limestone, marine	6	0
Scrubgrass	Coal, local	0	6
	Shale, carbonaceous	5	0
Clarion, No 4A	Coal, patchy	4	0
	Clay, flint and plastic	5	0
Canary	Ore, local	0	6
Clarion	Sandstone, irregular	10	6
Winters	Coal, local	1	0
Zaleski	Flint, impure, marine	1	0

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[3] Marine members are italicized

Ogan	Coal, local	1	0
	Shale and sandstone	25	0
Putnam Hill	Limestone, marine	4	0
Brookville No 4	Coal, steady	2	0
	Total average thickness	212±	0

This is the accepted number of marine members in the Allegheny formation of Ohio at present, and Wanless (1939, p 47) has stated that the Washingtonville shale "is the highest marine horizon in the Allegheny of the Appalachian field"

FIG 1 East approach to the L and M Coal Co s strip mine on the southwest side of the Dorr Run valley, section 31 Ward Tp Hocking Co, Ohio The strip mine lies behind the tipple

DESCRIPTION OF DORR RUN SHALE

At present the Geological Survey of Ohio has in progress a stratigraphic and economic survey of the Hocking Valley area in which we are participating During this work we have found a marine or brackish water shale member overlying the Lower Freeport coal in Athens (Sturgeon) and Hocking (Merrill) counties We are not the first to find or recognize this fossiliferous member, for E B Andrews as early as 1870 (1871, p 87) found and recorded fossil *Lingula* above the Lower Freeport coal in the vicinity of Kimberly which is located on Minkers Run (also called Meekers Run) near Nelsonville in Athens County Sturgeon rediscovered *Lingula* specimens at Kimberly in 1945 and learned of Andrews' original discovery in a search through the literature He called the junior author's attention to them during the field work of the present (1948) season The shales in which these fossils occur are similar to other shales in the section and hence do not stand out lithologically, and the inconspicuous fossils are relatively few in number and kind

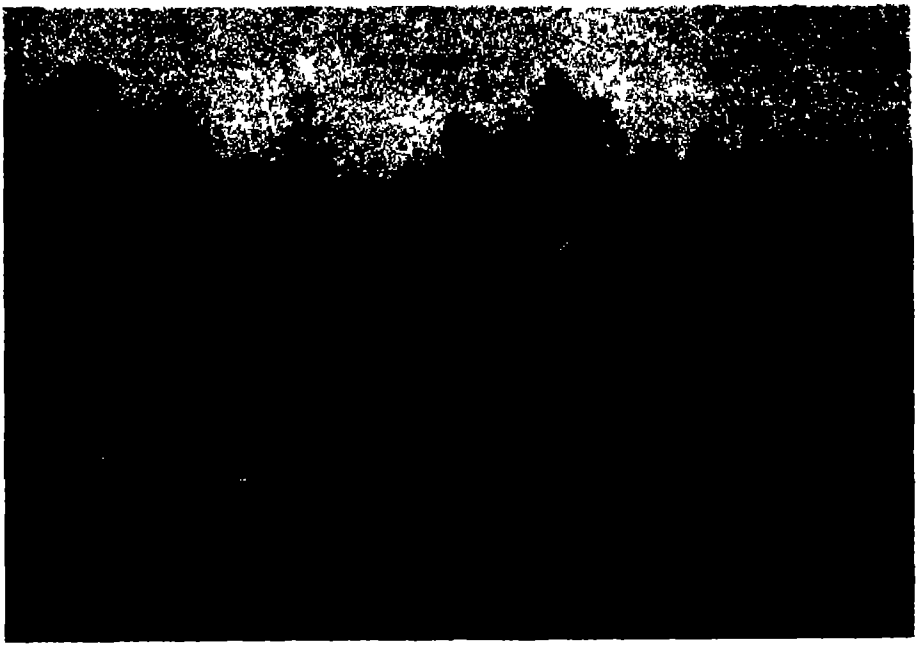

FIG 2 Strip mine of the L and M Coal Co section 31, Ward Tp, Hocking Co, Ohio Arrow points to Lower Freeport coal and Dorr Run shale

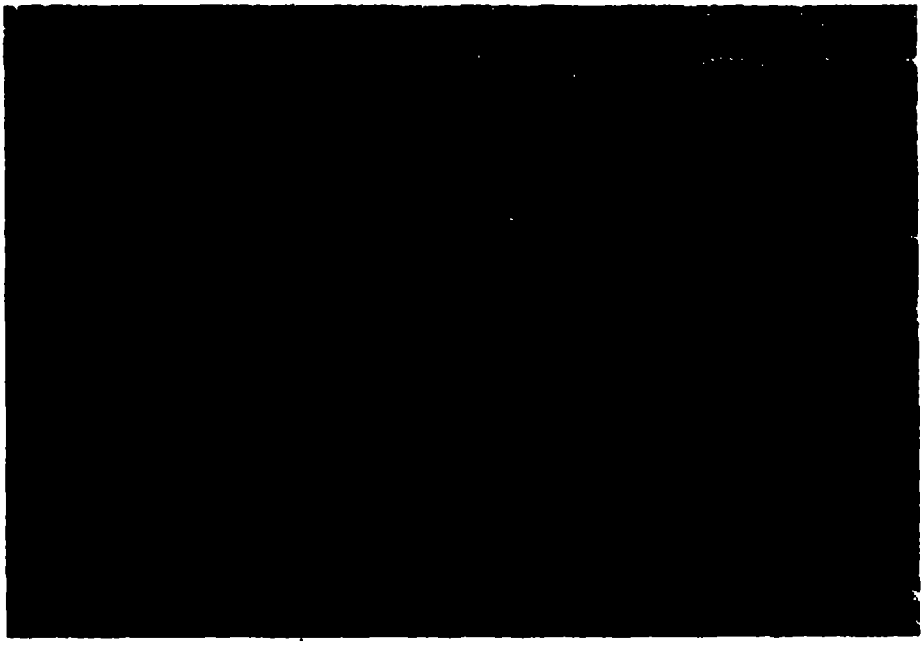

FIG 3 Close view of Lower Freeport coal and Dorr Run shale shown in Fig 2 White lines indicate top and bottom of the Dorr Run shale Figs 2 and 3 show the type exposure of the Dorr Run shale

The more abundant fossils are *Lingula* and pectinoid clams, but other brachiopods and clams as well as gastropods, cephalopods, scaphopods, conodonts, and fish remains do occur In view of the facts we believe it desirable to describe and name this member so that fellow workers in the Pennsylvanian of eastern Ohio will be on the alert for its occurrence elsewhere in the State

We propose the name Dorr Run shale for this fossiliferous member overlying the Lower Freeport coal from an exposure on the southwest side of Dorr Run valley 1 6 miles northwest of the junction of the road along Dorr Run with the Logan-Nelsonville road (Route 33, mileage is from the junction of old Route 33 as shown on the topographic map and not from the present newer location of Route 33) The type section, located in the SW¼, NW¼, section 31, Ward Township, Hocking County, Ohio, is in an abandoned strip mine, but the entire section includes strata exposed along the side road from the vicinity of the 741 (elevation on topographic map) road intersection in the SE¼, NW¼, section 31 The strip mine was formerly operated by the L and M Coal Co (now Liden Coal Co) on the property of William Bowers and was first studied by Merrill We have selected this exposure as the type not only because of its accessibility and probability of remaining exposed but also because it comes about as near as any exposure known to us of fulfilling the marine part of a typical cyclothem, although even here it is far from complete and typical (Figs 1–3) The following section gives the succession of strata exposed both in the strip mine and along the secondary road extending from the Dorr Run road

		Ft	In
32 Sandstone, brown to gray with limonite stained surfaces fine grained, micaceous laminated thin bedded or cross bedded with few greenish shaly layers near top	*Upper Freeport*	5	4
31 Clay-shale gray very sandy micaceous		0	8
30 Clay shale, dark gray to black some limonite stain on surfaces, silty		3	8
29 Clay-shale, brown, ferruginous silty		0	4
28 Shale gray to olive drab, clayey to sandy micaceous		2	11
27 Shale, gray to dark gray argillaceous fossiliferous clams with scattered, small limonite nodules in upper part	*Dorr Run*	1	10
26 Shale dark gray to black fossiliferous		1	7
25 Coal bony shaly, fossiliferous		0	4
24 Shale, black carbonaceous argillaceous fossiliferous		0	6
23 Coal, shaly to bony some bright streaks	*Lower Freeport*	1	1
22 Clay-shale, dark gray carbonaceous		0	6
21 Coal, bright, somewhat blocky in thin layers		1	2
20 Clay greenish gray, sandy, micaceous, slightly plastic darker gray and more clayey with coaly streaks near top		4	6
19 Sandstone gray to greenish gray, fine grained, micaceous, thin bedded		6	4
18 Sandstone, brown to buff, medium to coarse grained, micaceous, massive		23	10

		Ft	In
17 Shale, gray silty, with coaly layers near base	*Middle Kittanning*	3	0
16 Coal, bright to bony, thickness variable		1	6
15 Clay, dark gray, plastic		0	3
14 Coal, bright, blocky		2	5
13 Clay-shale, dark gray		0	2
12 Coal bright, blocky		0	10
11 Clay gray, sandy, plastic		1	0
10 Covered interval		15	0
9 Shale, greenish gray silty	*Lower Kittanning*	15	3
8 Coal, weathered		0	3
7 Clay, poorly exposed		2	9
6 Sandstone, buff to brown, medium grained, medium bedded near base, micaceous, ferruginous, grades upward into light gray to white fine grained, thin bedded argillaceous, micaceous sandstone		49	11
5 Covered interval		9	9
4 Shale, gray, argillaceous, containing layers and small nodules of limonite		8	0
3 Shale, gray argillaceous fossiliferous	*Putnam Hill*	0	6
2 Coal, shaly to bright	*Brookville*	0	1
1 Clay, light gray with dark gray top very plastic		5	4

A comparison of the strata associated with the Lower Freeport coal in the above section with a theoretical complete cyclothem shows that the freshwater limestone (3), calcareous shale (7), marine limestone (8), and shale containing clay ironstone bands and thin limestones (9) are absent in the type section of the Dorr Run shale Possibly the shale bearing the fossil clams (27) is a feeble representation of the calcareous shale (7) of a complete cyclothem

A freshwater limestone in or below the Lower Freeport underclay is present at many places in Ohio as is shown in the following section measured along a secondary road at the ridge crest south of Snake Hollow in NW¼, NE¼, section 18, York Township, Athens County

		Ft	In
8 Shale, gray to olive drab			
7 Shale, gray argillaceous, sparingly fossiliferous in basal 2 inches	*Dorr Run*	0	8
6 Coal, bright, blocky, with numerous, thin dull, irregular partings including much fusain, free sulphur on weathered surfaces	*Lower Freeport*	1	0
5 Shale dark gray to black carbonaceous with numerous fossil megaspores and thin coaly partings		0	2
4 Coal, bright blocky, with numerous dull partings of fusain and some pyrite, melanterite and free sulphur on weathered surfaces		0	5
3 Clay, gray ferruginous silty sandy micaceous with scattered small, limonite and pyrite concretions		5	10
2 Limestone greenish gray nodular ferruginous with net work of thin irregular limonite partings and with some pyrite embedded in light gray clay shale		2	0
1 Shale gray to olive drab			

Here the Lower Freeport limestone is well developed, nodular, and ferruginous A casual inspection at this locality did not show any fossils in the limestone, but a freshwater fauna of at least clams, ostracodes, and annelid worm tubes is present in the Lower Freeport limestone locally elsewhere in Ohio The fossils in the Dorr Run shale seem to be restricted to the several inches immediately overlying the coal It is possible, however, that fossils are present higher above the coal but unrecognizable because of the weathered condition of the shale

Plate I is a chart which shows the thickness and character of the Lower Freeport coal and Dorr Run shale at all localities where we have found fossils in the Dorr Run shale We have failed to find fossils above the same coal at other places within the area shown in the index map of Plate I, but we believe that fossils must certainly be present at some of the localities inspected and found wanting because of the weathered and slumped condition of the outcrop It should be mentioned that weathered and slumped conditions do not prevail at all locations where no fossils were found The following are descriptions of the locations at which the Lower Freeport and Dorr Run members are shown on Plate I The elevation given for each location below is approximate for the Lower Freeport coal and the Dorr Run shale

1 Exposure in L and M Coal Co s abandoned strip mine on the southwest side of Dorr Run valley, SW¼, NW¼, section 31 Ward Tp Hocking Co , Ohio This is the type exposure of the Dorr Run shale Elevation 910±
2 Exposure on west side of Nelsonville-Minkers Run road SW¼ SW¼, section 24 (unnumbered on topographic map), York Tp , Athens Co , Ohio Elevation 800±
3 Exposure on west side of Nelsonville-Minkers Run road SE¼, NE¼, section 29, York Tp , Athens Co , Ohio Elevation 830±
4. Exposure in abandoned strip mine on north side of Minkers Run valley and northwest of Kimberly, NW¼, SE¼, section 16, York Tp , Athens Co , Ohio Elevation 780±
5 Exposure in abandoned strip mine on south side of Minkers Run valley and west of Kimberly, south center section 16, York Tp Athens Co Ohio Elevation 785±
6 Exposure in abandoned strip mine north of Route 33 and east of Happy Hollow road, SW¼ SW¼ section 11 York Tp , Athens Co , Ohio Elevation 735±

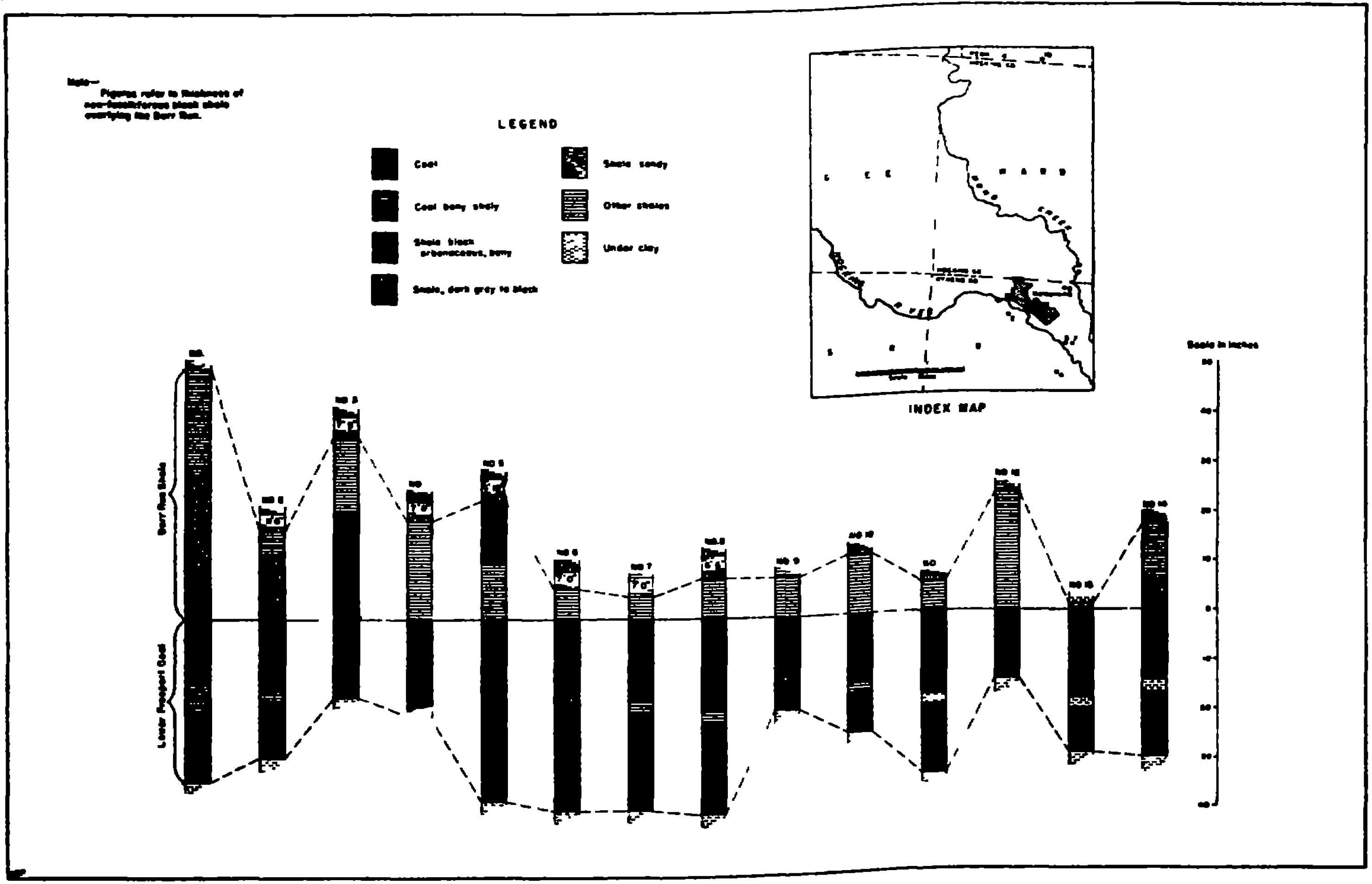

Chart showing thickness and character of the Lower Freeport coal and Dorr Run shale at all known exposures of the Dorr Run shale, 7 Exposure on west side of Happy Hollow road and short distance north of Route 33, NW¼, SW¼, section 11, York Tp Athens Co , Ohio Elevation 735±

8 Exposure at abandoned mine entrance on north side of Route 33, NE¼, SE¼, section 17 (unnumbered on topographic map) York Tp , Athens Co Ohio Elevation 733±

9 Exposure along both sides of secondary road at ridge crest south of Snake Hollow, NW¼ NE¼ section 18 York Tp Athens Co Ohio Elevation 790±

10 Exposures in ravine on northeast side of Route 216 SW¼ SW¼, section 33, Coal Tp , Perry Co , Ohio Elevation 890±

11 Exposure on west side of road SE¼ NW¼, section 23 Ward Tp Hocking Co , Ohio Elevation 890±

12 Exposure on north side of road just south of Downhour School NW¼ SW¼ section 29, Ward Tp , Hocking Co , Ohio Elevation 920±

13 Exposure on north side of road at crest of hill between 992 and 828 road intersections, NE¼, SE¼ section 22, Green Tp , Hocking Co Ohio Elevation 1045±

The 14th stratigraphic section on Plate I is an average composite one of the Lower Freeport coal and Dorr Run shale for the localities at which we have found the Dorr Run shale In the area studied by us the Lower Freeport coal has an average thickness of 30 inches and characteristically has a single parting of shale or clay with an average thickness of 2 5 inches The average thickness of the lower bench of coal is 13 inches and of the upper bench 14 5 inches The Lower Freeport where associated with the Dorr Run shale is not a coal of the highest quality and while much of it is bright and blocky it tends to have considerable fusain and pyrite and locally to become shaly and bony

The Dorr Run shale has a known average thickness of 17 inches It is very probable that the average thickness is too small, for a more thorough search would likely reveal fossils scattered through part of the considerable thickness of dark shale that overlies the Lower Freeport coal in part of York Township of Athens County The Dorr Run member is typically a gray to dark gray or even black, argillaceous, carbonaceous, fossiliferous, marine shale, but in the vicinity of Downhour School in Ward Township of Hocking County it is light gray and argillaceous The typical Dorr Run shale is lithologically quite similar to the type Washingtonville shale, but except for the pectinoid clams the faunas of these two shales do not seem very much alike Studies when complete, may show more similarities than are now apparent between these two faunas

On the basis of the stratigraphic evidence available we suggest the following addition and modification to the Lower Freeport cyclothem in Ohio

		Ft	In
6 Shale gray to olive drab silty to sandy			
5 Shale gray to black argillaceous and/or carbonaceous fossiliferous marine locally present	*Dorr Run*	1	6
4 Coal, locally present		1	0
3 Underclay impure	*Lower*	2	6
2 Limestone freshwater locally present		t	0
1 Sandstone and shale	*Freeport*	25	0
Disconformity			

The only change that we have made is the addition of the Dorr Run shale member, and for the remainder of the Lower Freeport cyclothem we have used Stout's descriptions and average thicknesses This seems feasible, since his studies are based on many sections over the entire eastern part of Ohio and our studies are of local extent In our sections, however, the Lower Freeport coal has an average thickness of about 30 inches and a 2 5-inch shale or clay parting near the middle (Plate I) The discovery of the Dorr Run shale member makes a total of three cyclothems in the Pennsylvanian of Ohio that are more or less complete Additional studies in Ohio and elsewhere may add facts that will warrant further modifications in our understanding of the Lower Freeport coal and associated strata

DORR RUN FAUNA

The better of the known collecting localities for Dorr Run shale fossils are at the type area and along the Nelsonville-Minkers Run road at localities 2 and 3 as shown on Plate I The fauna is not large and has not been completely studied, but our present knowledge indicates that the assemblage of fossils is more extensive than we believed at the beginning of our joint study There have been collected about 18 different kinds of Dorr Run fossils to date, but several of these because of poor preservation or of too few specimens are very inadequately represented The tentative fossil list, including genera and species as far as possible, is as follows

I BRACHIOPODA
  1 *Lingula carbonaria* Shumard
  2 *Orbiculoidea missouriensis* (Shumard)

II PELECYPODA
  1 *Aviculopecten* aff *eaglensis* (Price)
  2 *Cardiomorpha* sp
  3 *Dunbarella knighti* Newell?
  4 *Naiadites* ? sp
  5 "Solenomya" sp

III GASTROPODA
  1 *Patellilabia* sp
  2 Unidentified pleurotomarid genus
  3 Unidentified high spired genus

IV SCAPHOPODA
  1 *Plagioglypta meekiana* (Geinitz)?

V CEPHALOPODA
  1 *Pseudorthoceras knoxense* (McChesney)?
  2 *Metacoceras* sp

VI CONODONTS
  1 *Hibbardella?* sp
  2 *Hindeodella* sp
  3 *Idiognathodus* sp
  4 *Ozarkodina* sp
  5 *Streptognathodus* sp

VII VERTEBRATA
  1 Fish scales and spines

The fossils and the lithology of the Dorr Run shale do not indicate a normal marine environment at the time of deposition but rather near shore and shallow water conditions Dr Youngquist, during his identification of the conodont genera, observed from their occurrence with fish remains and fragments of fossil wood, that the environment was "perhaps a near shore, estuary or lagoon facies " He was particularly interested in the association of the conodonts with the remains of fish and plants, both associations of which, he points out, are known elsewhere Dr Newell after an inspection of the Dorr Run pelecypods believes "that the pelecypods are marine, although they may be representatives of a subnormally saline marine environment "

The absence of brachiopods with calcareous shells and of other fossils commonly found in the Pennsylvanian marine members of Ohio may further substantiate a shallow water, near shore environment, although the dark muds were certainly in part responsible for the absence of some of them The few cephalopod and gastropod shells may have floated in after the death of their owners, but such a means of transportation seems unlikely for the scaphopod shells which are open at both ends

The dark gray to black color of most of the shale should be indicative of a considerable amount of contained carbonaceous matter The fossil plants, while not abundant, include both woody material and a few leaves These facts probably also indicate a near shore environment A recent chemical analysis of the dark gray and black shale from locality 4 near Kimberly by the Geological Survey of Ohio showed, however, that the shale is more than 90% ash

From the available evidence it seems probable that the Dorr Run shale represents the black shale which is the basal marine unit of a typical cyclothem Marine conditions seem to have developed no further in Dorr Run time and instead were shortly replaced by the deposition of dark muds under a continental environment The sea threatened an invasion but never firmly established itself in Ohio during the deposition of the Lower Freeport-Dorr Run cyclothem

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A STUDY OF THE ADULT MOSQUITO POPULATION OF A NORTHERN OHIO WOODS

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The data presented in this paper are based on collections made by the author at various times over a two-year period, 1946–1948 The work is being carried out much more intensively at the present time so a more detailed report should be forthcoming, however, the present paper, at least, lists the species so far collected

The area studied is shown on the Cleveland Quadrangle, U S Geological Survey Map (Fig 1), and covers an area of only four square miles mostly because of the author's lack of sufficient transportation Much of the region is approximately seven hundred seventy feet above mean sea level with three valleys having approximate depths of eighty feet cutting through close to the laboratory The top land is mostly utilized by market gardeners, but open grassland is common In the ravines, trees and shrubbery grow in abundance

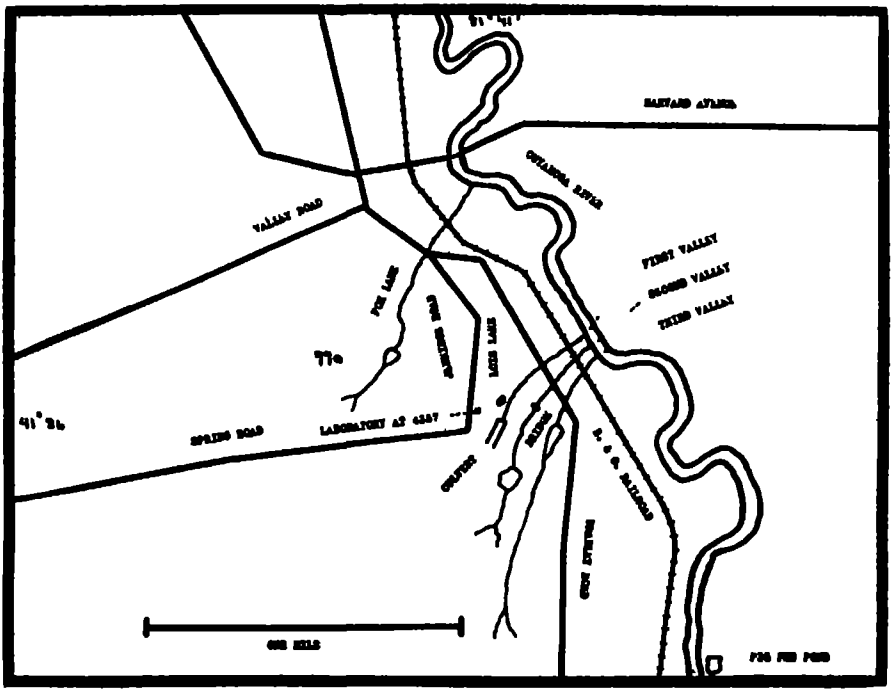

Fig 1 Map of area (Cleveland Ohio)

Dominating species of trees are the Tulip Tree, *Liriodendron tulipifera* L , and Beech, *Fagus americana* Sw , with Sycamores, *Platanus occidentalis* L , and Hop Hornbeams, *Ostrya virginiana* K , abundant Other plants include most of those generally found in beech-maple climax forests Because much of the land is water-logged, marsh-dwelling plants are common The Jewel Weed, *Impatiens* *biflora* Walt , immediately fills in any area left open by eroding of a bank or the death of a tree Water-holes, almost completely filled-in with leaves, are common, and wherever these are exposed to sunlight, aquatic plants such as Cattails, *Typha latifolia* L , Arrowheads, *Sagittaria cuneata* S , and Hornwort, *Ceratophyllum demersum* L , grow profusely

Mosquito collections and identifications were made according to methods generally used by workers in that particular field The bibliography lists two references which describe the subjects fully

ADULT COLLECTIONS

Indoors (evening)	(72 adults)
Culex restuans Theobald	45%
Culex pipiens Linnaeus	30
Anopheles punctipennis Say	20
Aedes triseriatus Say	5

Rain water barrels situated close by served as the breeding place for *C restuans* *A punctipennis* adults were found flying about indoors as late as November

Outdoors (evening—not biting)	(23 adults)
Aedes vexans Meigen	92%
Culex salinarius Coquillett	8

Winter Resting Places	(346 adults)
Culex restuans Theobald	98%
Culex pipiens Linnaeus	2

Summer Resting Places	(184 adults)
Culex salinarius Coquillett	40%
Culex restuans Theobald	40
Anopheles punctipennis Say	4
Culex apicalis Adams	4
Uranotaenia sapphirina Osten Sac	4
Megarhinus septentrionalis D & K	4
Unknown	4

Light Trap Collections	(211 adults)
Culex restuans Theobald	43%
Aedes vexans Meigen	34
Anopheles punctipennis Say	5
Mansonia perturbans Walker	5
Culex pipiens Linnaeus	3
Culex salinarius Coquillett	2
Aedes triseriatus Say	2
Culiseta morsitans Theobald	1 5
Culex apicalis Adams	1 5
Uranotaenia sapphirina Osten Sac	1 5
Culex erraticus Dyar & Knab	1 5

Biting Stations	(586 adults)
Aedes vexans Meigen	51%
Aedes canadensis Theobald	14
Mansonia perturbans Walker	13
Aedes triseriatus Say	6
Anopheles punctipennis Say	4
Culex salinarius Coquillett	3
Aedes trivittatus Coquillett	2
Culex restuans Theobald	1
Aedes excrucians Walker	9

Culex erraticus Dyar & Knab	7
Anopheles quadrimaculatus Say	7
Aedes fitchii Felt & Young	7
Aedes stimulans Walker	6
Aedes sticticus Meigen	6
Unknown	6
Aedes cinereus Meigen	4
Aedes thibaulti Dyar & Knab	4
Culex apicalis Adams	4

The last species on the list above was represented by a single specimen, gorged with blood, which did not attempt to bite but insisted upon resting on the arm of the author along with others which were feeding

The "Unknowns" were specimens which were damaged so badly that they could not be identified *A quadrimaculatus* was a fierce daytime biter when its resting place was invaded Up to the present time, no distribution pattern could be determined for the various larvae found

A biting station was set up adjacent to a temporary pool, labeled "Pig Pen Pond" on the map, during the last week of May, 1948 Ninety-seven adults were collected within twenty minutes, as listed below, but since the station was somewhat away from the points where most of the other collections were made, the results were not included in with the others Large numbers of *Culex apicalis* larvae were collected in the water

	Adults
Aedes stimulans Walker	61
Aedes fitchii Felt and Young	18
Aedes excrucians Walker	11
Aedes vexans Meigen	7

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AN ECOLOGICAL COMPARISON BETWEEN THE AVIFAUNAS OF OHIO AND DENMARK

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INTRODUCTION

It is always of great interest for the ornithologist to visit new areas and see new birds When in a new region the ornithologist invariably compares the new area with his home region, looks for birds he knows and birds he does not know, and all of what he sees is grouped and arranged according to how the bird life is back home

When the ornithologist finds himself in quite another part of the world he first really starts in to wonder and compare Familiar species are greeted as old friends, species closely related to familiar ones enter as components of the avifaunistic picture, substituting well-known ones New and unknown species are studied with the eagerness of a curious boy in the woods

Gradually the bird communities of the new area are dissolved in their components, species, that at the beginning seemed so unfamiliar, are now found to occupy the same ecological niches as some known species back home

Finally, after having been in the new area a sufficient length of time, the ornithologist feels more or less "at home," because the composition of various bird communities now seems familiar

I have had the opportunity now for two years to study at the Ohio State University, Columbus, Ohio, as a Research Fellow of the Ohio Wildlife Research Unit Coming from my cooler northern homeland, Denmark, the stay in this much more southern area has been of utmost interest and fascination to me My first meetings with hummingbirds and vultures will always be red letter days for me

The objective of this study is to show similarities and differences in the avifaunas of these two widely separated regions and attempts to explain some of the reasons underlying those conditions

The justification for presenting this paper is the fact that Ohio and Denmark, in spite of their belonging to two different continents and placed at quite different latitudes, yet show a degree of similarity in avifaunistic composition This is most pronounced with the shoreline community, of which Denmark can show a high diversity and richness, whereas the Lake Erie shoreline of Ohio is but a small part and in many places little or not at all suitable for shorebirds and waterfowl

CHARACTERISTIC FEATURES OF OHIO AND DENMARK

The location of Ohio and Denmark on two different continents and at quite different latitudes does not suggest many possibilities of similarity in general features Yet, several conditions are more or less alike, e g , the land-use patterns On the other hand, many differences occur, as the very hot Ohio summers, the

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The author wishes to express appreciation and thanks to Dr Daniel L Leedy, Leader the Ohio Wildlife Research Unit, Dr John N Wolfe the Ohio State University, Dr S Charles Kendeigh, the University of Illinois, Dr Edward S Thomas, the Ohio State Museum, and Dr Finn Salomonsen, Universitetets Zoologiske Museum, Copenhagen, for their helpful suggestions in the preparation of the manuscript

intensive and violent rains of Ohio, the light summer nights of Denmark, and many other characteristic features of the two countries

It has therefore seemed advisable, before making an avifaunistic comparison, to discuss briefly the most conspicuous similarities and differences in the general features of the two areas

(a) *Climate*

The rather great differences in the climates of Ohio and Denmark are due not only to the different geographical positions, Ohio being situated at around 40° n lat, Denmark at 56° n lat, but also by the fact that Ohio has a continental climate as part of a vast continent, whereas Denmark has an insular or maritime climate, tempered by the surrounding sea

The greatest differences, which also will appear from the graph, Fig 1, may be summarized as follows (data from Alexander and Patton, 1929, and H Larsen & Bo Bramsen, 1943)

Ohio has rather cold winters with unsteady cold weather, the winter is characterized by relatively little snow, occasional extremely low temperatures occurring during cold spells and many thaws and fairly mild weather between the cold spells

Denmark has fairly mild winters considering its northern location, with prolonged cold periods when winter really starts in, which does not happen every year, however, the winters of 1940–42, and 1947 were extremely long and cold The cold is more steady, with periods of continuous frost lasting as long as 40 days

Ohio has very hot, sunny and long summers, whereas the summers of Denmark are short and cool with much less sunshine Some summers only a week or a few weeks are vacation weather with sunshine and warmth in Denmark Denmark has an esthetic and practical advantage over Ohio in its light summer nights, characteristic of the northern latitudes, namely, in the months of May, June and July

The annual mean temperature for Ohio is 10 5° C, in Denmark 7 4° C The highest temperature measured in Ohio is 45° C, in Denmark 35 8° C The lowest temperature measured in Ohio is −39° C, in Denmark −31° C

The rainfall in Ohio is great, averaging 988 mm a year, maximum precipitation a year, 1,278 mm, the driest year had 711 mm rainfall The rainfall in Denmark is relatively slight, averaging 612 mm a year, maximum precipitation a year, 805 mm, driest year, 491 mm

The relative humidity is less in Ohio than in Denmark, averaging 71 and 83 per cent respectively

Ohio averages many more hours of sunshine than Denmark and as examples the figures for the summer months may be given In June Ohio has 306, Denmark 261 hours of sunshine, in July Ohio has 327, Denmark 250 hours of sunshine, and in August Ohio has 286, Denmark 227 hours of sunshine

Finally, it may be mentioned that it is very windy in Denmark Annually only 4% of the days are calm, the force of the wind averages 6–8 m per second (in winter 7 5, in summer 6 1) Highest wind velocity measured in Denmark was 35 m per second

(b) *Topography and land-forms*

Parts of Ohio and Denmark are similar in topography, namely, the flat regions of unglaciated Ohio and the flat, tundra-like heath of unglaciated western Denmark and to some extent also rather flat areas on some of the islands Eastern Ohio is hilly and undulating and is similar to parts of eastern Jutland

The characteristic features of Denmark are its long shoreline, the long fjords cutting into the country, the many (483) islands scattered around in the sea, the bays and marshes, the heath, and the sand-dunes along the sea-shore Ohio has nothing comparable to these features, except for the Lake Erie-shoreline and the Bass Island group in the lake Rocky islands, belonging to Denmark, are found in the Baltic Sea

Taken as a whole, however, the two areas are dissimilar Greatest similarity is found between the Lake Erie shoreline of Ohio and the Danish sea-shoreline, and as it will be shown later on, it is in these areas that the greatest similarities are to be found in the avifauna of the two countries

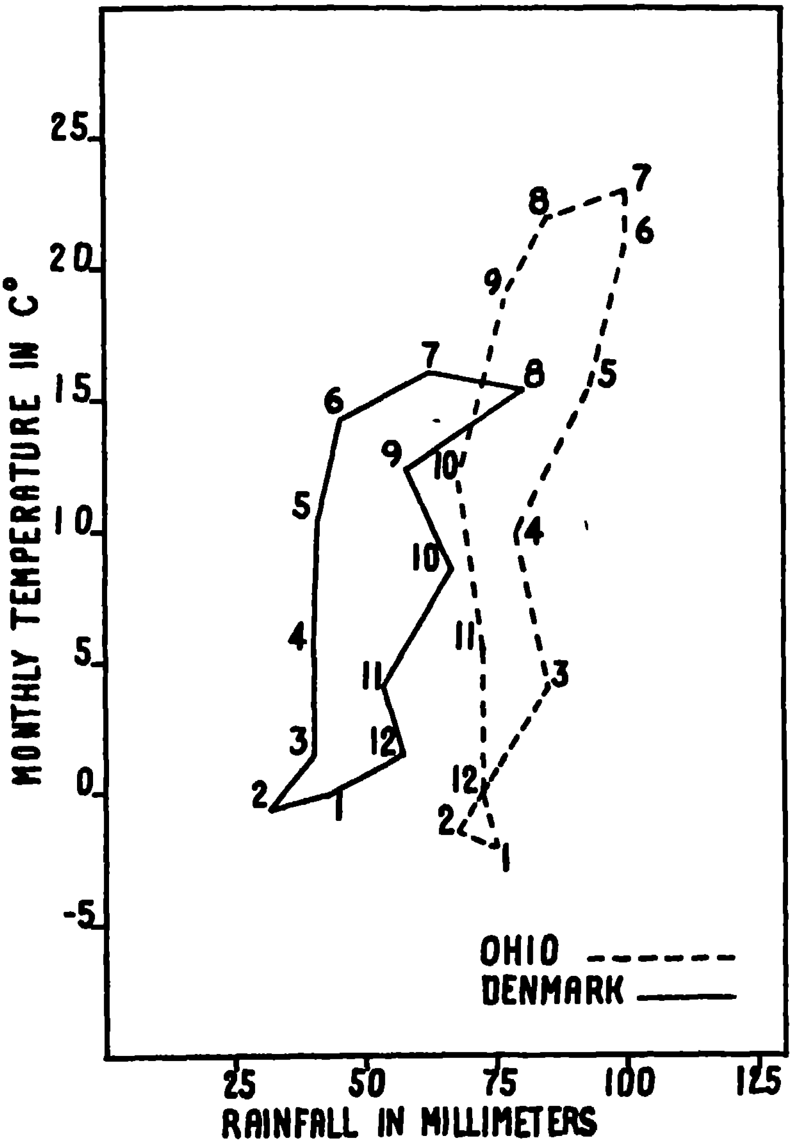

Fig 1 Climograph of Ohio and Denmark Months are indicated by the numbers 1-12

(c) *Vegetation*

Ohio has a rich and varied flora composed of approximately 2200 flowering plants (including 500 introduced species), 69 ferns, and 700 mosses and lichens Several forest climaxes are found, as Mixed-mesophytic and Hemlock-Beech, the most common trees are the oaks, comprising 39 3% of the total forest area, followed closely by beech, maples, elm, ashes, hickories, etc In all 120 varieties of native trees are found in Ohio In the southeastern and eastern parts of the state conifers occur on drier sites, most common are Virginia pine, ***Pinus virginiana***, and Pitch pine, ***Pinus rigida*** Fourteen per cent of the total area is forested, and of this area 99% is deciduous forest, and 1% conifers

Except for the forest land the main part of Ohio is farmland without characteristic or outstanding plant communities

The vegetation of Denmark is central European with northern and boreal characteristics in certain areas, e g , the heath The flora is composed of about 1400 species of flowering plants, 30 ferns and 450 species of mosses and lichens The climax forest type is deciduous forest with beech, ***Fagus silvatica***, as the main tree, but, in addition, oaks, ashes, linden, birch, elm, etc , are found In Jutland the dominating forest type is conifers, mainly Norway spruce, ***Picea abies***, pines and firs, 8 5% of the land area is forested, and of this area 43% is deciduous forest, and 57% conifers Characteristic for the Danish forest is its few tree species, the 5 main species occupying as much as 84% of the total forest area

Another characteristic of the Danish flora is the tundra-like heath in the former unglaciated part of western Jutland, the heath, bogs and sand-dunes occupy about 10% of the total land area The characteristic plant of the heath is heather, ***Calluna vulgaris***, and other common species are cranberry, ***Vaccinium vitis-idaea***, black crow-berry, ***Empetrum nigrum***, lichens and mosses

Along the west coast of Jutland and also in other places several rows of sand-dunes are found, building a barrier against the violent storms from the sea Characteristic plants of the sand-dunes are lyme-grass, ***Elymus arenarius***, and sea sand-reed, ***Ammophila arenaria***

(d) *Land-use*

The land-use in Ohio and Denmark is similar in that farm land occupies about three-fourths of the total area, and the rest is occupied by forests, towns, roads, etc Denmark has a 10% area, namely heath, bogs and sand-dunes, of which no comparable unit is found in Ohio

Both states are thus mainly agricultural, but differences in crops, farming methods and soil types result in a rather different general appearance of farm lands Ohio farms are rather large, averaging 99 acres per farm, whereas the average Danish farm covers 42 acres Several big estates, comprising many hundred and up to several thousand acres are found in Denmark Most of the farm land in Denmark is more rolling than in Ohio Ohio fields are much bigger than average Danish fields, Ohio fields are mostly rectangular and regular in shape, whereas most Danish fields (mainly because of age and the very early dividing up of land) are rather irregular in shape Many fields in Denmark are divided by living fencerows, and, in Jutland, windbreaks are very common As a matter of fact they are a necessity for man's existence in that region In Ohio, corn, wheat, oats and soybeans are the main crops, whereas in Denmark, barley, oats, beets and rye are the main crops

The population density is a little different in the two areas In Ohio there are 168 inhabitants per square mile (1940), in Denmark there are 244 inhabitants per square mile (1945)

TABLE I

LAND-USE PATTERNS IN OHIO AND DENMARK

	Ohio (1930)	Denmark (1931)
Farm land	82 0%	75 0%
Forests	14 0%	8 5%
Heath dunes		10 0%
Towns gardens, etc	2 0%	2 5%
Roads, hedges	2 0%	2 0%
Lakes and streams		2 0%

A COMPARISON OF OHIO AND DENMARK AVIFAUNAS TO SPECIES

The results of a comparison between Ohio and Danish avifaunas depend entirely upon how such a comparison is made

If the list of identical species, given in Table 2, is used as a basis, without further consideration, it will be seen that ca 100 species are alike, and it might accordingly be concluded that the avifaunas are much alike, almost 30% of the species being identical

If a visit were made to a Lake Erie marsh or another waterfowl area, the number of various ducks, terns, gulls, bitterns, gallinules, coots, etc , would make the Dane feel very much at home

If on the other hand a visit were made to Neotoma Valley in Hocking county, the differences would be so striking, that the Dane could hardly find one familiar species

Similarly an Ohioan would feel homesick and helpless if put out on the tundra-like heaths and moorlands of western Jutland in Denmark, even the bird life of the woods would be new and unknown to him

A closer consideration of the whole matter would therefore seem desirable

For this reason a list (Table 2) is first given to be used as a basis for a qualitative comparison

As indicated in Table 2, a total of 99 species of birds have been recorded from both Ohio and Denmark This means that 29% of the birds recorded in Ohio have been reported in Denmark, and that 30% of the birds recorded in Denmark have also been reported in Ohio

The total number of species recorded in Ohio is 343 (Trautman, 1935 331 species, plus 12 species by Borror, 1941) of which 152 or 44% of the total number are regular and fairly common to common breeding birds

The total number of species recorded in Denmark is 334 (Løppenthin, 1946 333 species plus pheasant, which species is included in the Ohio list, too), of which 159 or 48% of the total number are regular, and fairly common to common breeding birds

Although one may get the impression that there is a fairly high similarity between the composition of the avifaunas of Ohio and Denmark, a close analysis will, however, show that this is not the case A very high number of the species are casual, several with only one record, in either or both lands, and only a few are common transients or breeding birds in both areas

Artificial introductions account for 6 species, namely, mute swan, European partridge, starling, and English sparrow, that have been introduced into the United States from Europe, and either released in, or spread from releases to, Ohio, Canada geese have been introduced to a bird park in Sweden from where they, during the winter, have migrated to Danish coasts, released Canada geese in Danish parks are now breeding in a few places The pheasant was introduced in both Denmark and Ohio

TABLE II

LIST OF BIRD SPECIES RECORDED

List of bird species recorded from Ohio and Denmark, showing subspecific similarities and differences, and stating respective occurrence System and nomenclature followed as by Løppenthin (1946), Ohio records after Trautman (1935) and Borror (1941) Key to symbols used C = Common, Ca = Casual (accidental or far from its usual range), E = Exterminated in Ohio, L = Local, M = Migrant, N = Nests, R = Rare, but few recorded yearly, Res = Resident, found at all seasons, Rec = Record, S = Summer, U = Uncommon, occurring but in small numbers, V = Very, W = Winter, ? = Old established record being questioned, due to lack of any proof Combinations as e g , VRM, mean accordingly very rare migrant A dash (—) under the subspecific heading means that no subspecies are found, and the species are thus identical

COMMON NAME	SCIENTIFIC NAME	SUBSPECIES IN		OCCURRENCE IN	
		Ohio	Denmark	Ohio	Denmark
Red throated loon	*Colymbus stellatus**	—	—	VRM	CW US
Black throated loon	*Colymbus arcticus*	—	—	?	CW US
Common loon	*Colymbus immer*	—	-	UM	UW RS
Horned grebe	*Podiceps auritus*	—	—	CM	UM UW
Eared grebe	*Podiceps nigricollis*	*californicus*	*nigricollis*	Ca	NL RM
Leach's petrel	*Oceanodroma leucorrhoa*	—	—	1 Rec	Ca.
Gannet	*Morus bassanus*	—	—	Ca.	LSW
Black-crowned night heron	*Nycticorax nycticorax*	*hoactli*	*nycticorax*	UM NL	Ca.
Eastern glossy ibis	*Plegadis falcinellus*	*falcinellus*	*falcinellus*	Ca	Ca
Mute swan	*Cygnus olor*	—	—	INTR	NC
White-fronted goose.	*Anser albifrons*	*albifrons*	*albifrons*	Ca	UM RW
Brant	*Branta bernicla*	*hrota*	*hrota*	Ca	CM CW
			bernicla		CM CW
Barnacle goose	*Branta leucopsis*	--	—	?Ca	UM UW
Canada goose	*Branta canadensis*	*canadensis*	*canadensis*	UM	INTR
Mallard	*Anas platyrhynchos*	*platyrhynchos*	*platyrhynchos*	CM NR	NC MC WC
Blue-winged teal	*Anas discors*	-	—	CM NL	Ca.
Green-winged teal	*Anas crecca*	*crecca*	*crecca*	Ca.	NL CM
		carolinensis	—	CM	
Pintail	*Anas acuta*	*tzitzihoa*	*acuta*	CM NR	NL CM
European widgeon	*Anas penelope*	—	—	VRM	NR CM
Gadwall	*Anas strepera*	—	—	UM	NR UM
Shoveller	*Spatula clypeata*	—	—	UM NR	NC CM
Greater scaup	*Aythya marila*	*nearctica*	*marila*	VR	CW RS
Golden-eye	*Bucephala clangula*	*americana*	*clangula*	UM WRes.	CM CW
Old-squaw	*Clangula hyemalis*	—	—	VUM	CW US
Eider	*Somateria mollissima*	*dresseri*	*mollissima*	Ca.?	NCL CM CW
King eider	*Somateria spectabilis*	—	—	VR	CaW
White-winged scoter	*Melanitta fusca*	*deglandi*	*fusca*	UM	CM CW
Goosander (Am merganser)	*Mergus merganser*	*americanus*	*merganser*	CM CW	NL CW
Red-breasted merganser	*Mergus serrator*	-	—	CM	NC CM CW
Osprey	*Pandion haliaetus*	*carolinensis*	*haliaetus*	UM NR	UM NR?
Goshawk	*Accipiter gentilis*	*atricapillus*	*gentilis*	RM RW	NU Res.
			buteoides		UM UW
Rough legged hawk	*Buteo lagopus*	*s johannis*	*lagopus*	UWRes.	CM CW
Golden eagle	*Aquila chrysaetos*	*canadensis*	*chrysaetos*	RWRes.	UW
Marsh hawk	*Circus cyaneus*	*hudsonius*	*cyaneus*	CM NL CWRes.	CM NRL UW
Gyrfalcon	*Falco rusticolus*	*obsoletus*	*rusticolus*	1Rec	RW
Peregrine falcon	*Falco peregrinus*	*anatum*	*peregrinus*	RM VRWRes.	NLR CM CW
Merlin	*Falco columbarius*	*columbarius*	*aesalon*	RM VRWRes.	UM RS

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* In American literature the loons are called Gavia.

Table II—(*Continued*)

COMMON NAME	SCIENTIFIC NAME	SUBSPECIES IN		OCCURRENCE IN	
		Ohio	Denmark	Ohio	Denmark
American kestrel	*Falco sparverius*	*sparverius*	*sparverius*	CRes.	Ca
Partridge	*Perdix perdix*	*perdix*	*perdix*	INTR	CRes.
Pheasant	*Phasianus colchicus*	mixed population	mixed population	INTR	INTR.
Moorhen (gallinule)	*Gallinula chloropus*	*cachinnans*	*chloropus*	UM NL	NC UM
Black-bellied plover	*Squatarola squatarola*	—	—	UM	CM
Semipalmated plover	*Charadrius hiaticula*	*semipalmatus*	*hiaticula*	UM	NC CM
Upland plover	*Bartramia longicauda*	—	—	UM NL	Ca
Hudsonian curlew (whimbrel)	*Numenius phaeopus*	*hudsonicus*	*phaeopus*	RM	CM US
Lesser yellow-leg	*Tringa flavipes*	—	—	CM	Ca.
Ruddy turnstone.	*Arenaria interpres*	*morinella*	*interpres*	VUM	NL UM
Long billed dowitcher	*Macrorhamphus griseus*	*scolopaceus*	*scolopaceus*	VRM	Ca
Wilson's snipe	*Capella gallinago.*	*delicata*	*gallinago*	CM	NC CM UW
Sanderling	*Crocethia alba*	—	—	UM	UM RW
Knot	*Calidris canutus*	*rufus*	*canutus*	RM	CM RS
Purple sandpiper	*Calidris maritima*	*maritima?*	*maritima*	VRM	UM UW
Red backed sandpiper	*Calidris alpina*	*pacifica.*	*schinzii* *alpina*	UM	NCL CM CM RW
Buff-breasted sandpiper	*Tryngites subruficollis*	—	—	VRM	Ca.
Ruff	*Philomachus pugnax*	—	—	2 Rec	NLC CM
Red phalarope	*Phalaropus fulicarius*	—	—	Ca	VRM VRW
Northern phalarope	*Phalaropus lobatus*	—	—	VRM	UM RW
Northern skua	*Stercorarius skua*	*skua*	*skua*	Ca	Ca.
Pomarine jaeger	*Stercorarius pomarinus*	—	—	Ca	UM
Parasitic jaeger	*Stercorarius parasiticus*	—	—	VR	UM RS
Long-tailed jaeger	*Stercorarius longicaudus*	*longicaudus?*	*longicaudus*	1 Rec	UM
Herring gull.	*Larus argentatus*	*smithsonianus*	*argentatus*	NL CM UWRes.	NC CM CW
Great black-backed gull	*Larus marinus*	—	—	C	NL CW
Glaucous gull	*Larus hyperboreus*	*hyperboreus*	*hyperboreus*	Ca	UW
Iceland gull	*Larus glaucoides*	—	—	VR	Ca.
Kittiwake	*Rissa tridactyla*	*tridactyla*	*tridactyla*	Ca	NL USW
Sabine's gull	*Xema sabini*	—	—	Ca.	Ca.
Black tern	*Chlidonias niger*	*surinamensis*	*niger*	UM NLC	NLC RM
Gull-billed tern	*Gelochelidon nilotica*	*aranea*	*nilotica*	?	NL RS
Caspian tern	*Hydroprogne tschegrava*	—	—	UM	NCa ? RM
Common tern	*Sterna hirundo*	*hirundo*	*hirundo*	CM NL	NC CM
Roseate tern	*Sterna dougallii*	*dougallii*	*dougallii*	Ca.	Ca
Least tern	*Sterna albifrons*	*antillarum*	*albifrons*	VR	NLC RM
Brunnich's murre	*Uria lomvia*	*lomvia*	*lomvia*	Ca	UW
Yellow billed cuckoo	*Coccyzus americanus*	*americanus*	*americanus*	CM NL	Ca
Barn owl	*Tyto alba*	*pratincola*	*guttata*	URes.	NC Res.
Snowy owl	*Nyctea scandiaca*	—	—	UWRes.	UWRes.
Hawk owl	*Surnia ulula*	*caparoch*	*ulula*	R VRN	RW
Long-eared owl	*Asio otus*	*wilsonianus*	*otus*	R VRN	NC UM UW
Short-eared owl.	*Asio flammeus*	*flammeus*	*flammeus*	UM VRN	NLC UM
Horned lark	*Eremophila alpestris*	*praticola* *alpestris*	*flava*	CM CN CWRes.	UM UW
Barn swallow	*Hirundo rustica*	*erythrogaster*	*rustica*	VCM CN	NC CM
Bank swallow	*Riparia riparia*	*riparia*	*riparia*	CM UN	NC CM
Raven	*Corvus corax*	*principalis*	*corax*	Ext	NL Res.

Table II—(*Continued*)

COMMON NAME	SCIENTIFIC NAME	SUBSPECIES IN		OCCURRENCE IN	
		Ohio	Denmark	Ohio	Denmark
Magpie	*Pica pica*	*hudsonia*	*pica*	Ca	NC Res.
Black-capped chickadee	*Parus atricapillus*	*atricapillus*	*salicarius*	URes.	VR?
Brown creeper	*Certhia familiaris*	*americana*	*macrodactyla*	CM UWRes.	NC Res.
			familiaris		NLC UW
Winter wren	*Troglodytes troglodytes*	*hiemalis*	*troglodytes*	CM UWRes	NC CM CW
Water pipit	*Anthus spinoletta*	*rubescens*	*littoralis*	CM	NL CM
Waxwing	*Bombycilla garrulus*	*pallidiceps*	*garrulus*	VRWRes.	CW
Northern shrike	*Lanius excubitor*	*borealis*	*excubitor*	VRWRes.	NL CM CW
Starling	*Sturnus vulgaris*	*vulgaris*	*vulgaris*	INTR.	NC CM
House sparrow	*Passer domesticus*	*domesticus*	*domesticus*	INTR.	NC Res.
Redpoll	*Carduelis flammea*	*linaria*	*flammea*	VRWRes.	CM CW
			holboellii		UW
		exilipes	*exilipes*	Ca.	Ca.
Pine grosbeak	*Pinicola enucleator*	*leucura*	*enucleator*	Ca	RW
Red crossbill	*Loxia curvirostra*	*pusilla*	*curvirostra*	VRWRes	NU UM
White-winged crossbill	*Loxia leucoptera*	*leucoptera*	*bifasciata*	VRWRes.	UW
Lapland longspur	*Calcarius lapponicus*	*lapponicus*	*lapponicus*	RWRes	UW
Snow bunting	*Plectrophenax nivalis*	*nivalis*	*nivalis*	RWRes	CM CW

The remaining 93 species can roughly be divided up into six groups

1 Species that are rare and casual in both areas, occurring as transients or visitors Leach's petrel, Eastern glossy ibis, king eider, golden eagle, gyrfalcon, long billed dowitcher, sanderling, buff breasted sandpiper, red phalarope, northern skua, Iceland gull, Sabine's gull, roseate tern, snowy owl pine grosbeak

Of the 16 species rare in both countries almost all of them are occasional stragglers from the north, exceptions are Eastern glossy ibis and roseate tern Eleven of them are water birds

2 Species that occur in small numbers, scarce or irregular in both areas are Common loon, and Caspian tern of which the latter is an irregular breeding bird in Denmark, breeding with an interval of many years Both are northern species

3 Species that are rare in the one and scarce or irregular in the other area

Species rare in Ohio, and scarce or irregular but more numerous in Denmark are Gannet, white-fronted goose barnacle goose, merlin purple sandpiper, northern phalarope pomarine jaeger, parasitic jaeger, long tailed jaeger, glaucous gull, Brunnich's murre, white-winged crossbill and Lapland longspur

These 13 species are all more northern breeding species the European gannets do, however, breed as far south as Wales in England Ten of the species are water birds

4 Species rare in the one and common transients in the other area

Species rare in Ohio, common in Denmark	Species rare in Denmark, common in Ohio
Rough legged hawk	Lesser yellow leg
Black bellied plover	
Hudsonian curlew (whimbrel)	
Knot	
Bohemian waxwing	
Redpoll	
Snow bunting	

Of the eight species in this group, seven, namely, those rare in Ohio, but common in Denmark, are northern species, three of them are water birds The bird rare in Denmark and common in Ohio, the lesser yellow leg, is an occasional straggler across the Atlantic.

5 Species breeding in one country, but not in the other

Species breeding in Denmark,
and not in Ohio

- Eared grebe
- Green winged teal
- European widgeon
- Gadwall
- Eider
- Goosander (Amer merganser)
- Red breasted merganser
- Goshawk
- Peregrine falcon
- Semipalmated plover
- Ruddy turnstone
- Wilson's Snipe[3]
- Red backed sandpiper
- Ruff
- Great black backed gull
- Kittiwake
- Gull billed tern
- Least tern
- Raven
- Magpie
- Brown creeper
- Winter wren
- Water pipit
- Northern shrike
- Red crossbill

Species breeding in Ohio
and not in Denmark

- Black-crowned night heron
- Blue-winged teal
- Osprey
- American kestrel
- Upland plover
- Yellow billed cuckoo
- Horned lark
- Black capped chickadee

An analysis of the above data shows that all of the 25 species, which are breeding birds in Denmark, but only transients or occasional visitors in Ohio (raven has been exterminated in Ohio), are without exception, northern species, 16 of them are water or wading birds

Of the eight species recorded in, but not breeding in Denmark four are occasional stragglers from North America, namely, blue-winged teal, American kestrel upland plover and yellow billed cuckoo, and each of them only recorded once in Denmark The black crowned night heron occurs as an occasional visitor from southern Europe the Scandinavian horned larks breed much farther north, namely, on the tundras and mountain plateaus of the Scandinavian peninsula (the complete difference in habitat and ecological requirements of Scandinavian and North American horned larks is so striking that a study of the subject might be worth while) Concerning the remaining two species, the osprey formerly bred commonly in Denmark, but is now exterminated, maybe one or a few pairs are still found, the subspecies of the black-capped chickadee is moving up into Denmark from the South, and is suggested as a possible breeding bird in southernmost Denmark (Løppenthin, 1946)

6 Species breeding in both countries are Mallard pintail, shoveller, marsh hawk, gallinule, herring gull black tern, common tern, barn owl long eared owl, short eared owl, barn swallow, bank swallow

With the exception of the marsh hawk, of which family two other species are more common breeding birds in Denmark all of the species mentioned in this group are common breeding birds in Denmark, whereas in Ohio only a few of them are so widely distributed in the state that they may be called common

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[3] Listed by Trautman (1935 7) as common migrant only Hicks (1935 152) lists it as a breeding bird in three northeastern counties, but says the "species is likely to disappear as a breeding bird within a few years "

Mallard, pintail, shoveller, herring gull, black tern and common tern are restricted to a few areas along or in Lake Erie, marsh hawk, gallinule, long-eared owl, and bank swallow are mostly found in the northern part of the state, short-eared owl scattered, but mostly in the northern part, barn owl over most of the state, but most common in the southern part of the state, barn swallow is found all over the state of Ohio Six of the 13 species are water birds.

POSSIBLE REASONS FOR SIMILARITIES AND DIFFERENCES IN AVIFAUNAS

What conclusions may be derived from the above given data concerning composition, quantity, and reasons for differences in the avifaunas of these two remote areas? First, let us consider the number of species recorded It is striking to see that Denmark, even if it is much smaller in area, has a list of species almost as long as that for Ohio (resp 334 and 343) If the number of species recorded were in the same proportion to a unit of land as in Denmark, there should have been 831 species recorded from Ohio Conversely, if the number of birds decreased in proportion to the unit of land there should only have been 138 species recorded from Denmark, which is less than the number of regular breeding birds in the country Interpretation of the foregoing statements should not be misconstrued It is not meant that the number of bird species within an area is proportional to the size of the area Many other factors such as variety of habitats, geographical location, isolation, climate and vegetation are of much importance in this respect Rather, it is the author's contention to point out the fact that more species could be expected from Ohio if its geographical location were similar to that of Denmark's The land areas of Ohio and Denmark are respectively 41,222 and 16,576 square miles

How does this diversity come about?

The reasons may be listed as follows

(a) Denmark is the apex of the European continent and as such the connecting link (flyways and migration routes) between middle and western Europe and Fenno-Scandia–Siberia, as well as many northern birds winter in Denmark

(b) Denmark is an archipelago consisting of one peninsula and 483 islands, thus getting its share of migrating and wandering around water birds

(c) Denmark, because of its position between southern and northern faunas, gets its share of both faunas, further occasional visits of southern birds, and all northern migrants

(d) Denmark has a diversity in vegetation, landscape form, and land-use not found in Ohio

(*a*) *Denmark as the apex of the European Continent*

The importance of peninsulas and islands as migration routes of birds has been known for a long time

Denmark's geographical position as an apex of the European continent, with the Jutland peninsula protruding north from the continent and the islands extending eastward to the southern part of Sweden, makes the country a natural bridge for many of the birds coming from northern Scandinavia and Siberia

Salomonson (1938 36) mentions how the ducks wintering in England were shown by banding to come from Denmark, Sweden, Finland, western Russia, Balticum, most of these birds migrating in a southwesterly direction over Denmark Blume and Frölich (1946) have recently shown how a great part of Scandinavian birds-of-prey migrate over the eastern part of Denmark

Many of the birds coming from the North winter in Denmark These include especially diving ducks in the seas around the country, but also loons, swans, certain birds-of-prey, and a few passerines, as the dipper, *Cinclus cinclus*, brambling, *Fringilla montifringilla* and snow-bunting, *Plectorphenax nivalis*

The migration of many species, (one good example is the wood cock, *Scolopax* *rusticola*), takes place from Jutland over Skagerrak to southern Norway or over Kattegat to Sweden These birds thus migrate over a broad front, and during the migration seasons are found over nearly the whole country in suitable habitats Others, as the above mentioned birds-of-prey, follow the eastern part of Sjælland and the smaller islands south of it As indicated by Holm (1940), ducks (especially diving ducks), breeding in the Baltic Sea and the Gulf of Bothnia, migrate along the eastern shores of Sweden and enter Danish waters around the southern tip of Sweden

As a matter of interest it should be pointed out that the Zoological Museum of Kõbenhavns Universitet has an agreement with the personnel of the Danish light-houses that all birds killed by flying against the light-houses and found at the light-houses are to be turned in to the museum A great number of birds are secured annually this way It might also be mentioned that duck traps were legal up to 1931 In one of these, on the island of Fanõ off the west coast of Jutland, 3100 ducks were caught annually from 1900–1927 (Weismann, 1939 267), indicating the number of ducks passing by

One difference between Ohio and Denmark is that Ohio as part of a vast continent, and without outstanding features of any kind to attract migrating birds, only gets a relatively small share of migrating birds, mostly land birds and birds migrating over a broad front, whereas Denmark lies on the direct migration routes and is passed by almost all of the birds migrating to or from Norway and Sweden, and also many birds from Finland, northern and western Russia and Balticum

(*b*) *Denmark as an Archipelago*

A comparison of the data in Table 2 and the other information given above shows that Denmark is ahead of Ohio concerning the frequency in which the different species in common occur, and further, that out of the 99 species, 63 (64 per cent) are water or wading birds, and of these 63 species 28 are more common in Denmark than in Ohio, and 15 of them breed in Denmark and not in Ohio

The difference in composition in the avifaunas will also appear from a consideration of the total number of birds listed for the two areas

Of Ohio's 343 species, 134 (39 per cent) are water or wading birds, of which 27 (20 per cent) do breed in Ohio

Of Denmark's 334 species, 153 (46 per cent) are water or wading birds of which 65 (42 per cent) do breed in Denmark, most of them abundantly

There can also be no doubt that several of the species which have occurred as occasional visitors in Denmark have come to the country because of its geographical position in the sea

Good examples, for upholding this hypothesis, are some of the stragglers from North America Blue-winged teal, lesser yellow-leg, and buff-breasted sandpiper, three species which undoubtedly never would have reached Denmark were it not for its location and connection with the Atlantic Ocean

It is also characteristic that where, e g , the lesser yellow-leg has occurred in Europe in addition to the Danish record it has been in countries with a seashore, namely, nine records from the British Isles, and it has also been recorded from Holland (Hõrring, 1942 45)

As another indicator of the importance of the surrounding sea the following might be mentioned From the area around Herning in the heart of Jutland, 54 km to the North Sea and one of the places in Denmark farthest away from the sea, Overgaard (1932) mentions 143 species of birds observed Wittrup Jensen (1937) observed 105 species of birds in Fyn, on a farm 4 km from the shore of the Great Belt In contrast to this, Harboe (1939) observed 173 species at Præstõ, at the seashore, and I have observed 194 species in my home region at Vejle, Vejle Fjord It is characteristic, too, that the birds that are lacking in making up the greater species list in the inland areas are water and shore birds

An illustration of the importance and abundance of the water bird group is also given in the annual kill records collected by the Danish Game Department

The latest figures are from 1945 (Dansk Jagttidende, 64 138), and show that the total kill of waterfowl, sea and shore birds for that year was

371 674 pond ducks
130 551 diving ducks
9,814 geese
79,875 gulls
20 906 other swimming birds
27 950 wood cocks
41,282 snipes
28 508 curlews
2 605 herons
20 684 other shore birds

In all, 1,033,849 waterfowl, sea and shore birds were shot, most of which are good eatable game birds

Comparable figures are unfortunately not available for Ohio, but the number of waterfowl shot is much less, and shore birds are not legal game birds in Ohio Daniel L Leedy's figures (1947 5) show that 2 03 per cent of Ohio's total game kill is ducks, 0 05 per cent geese, and 0 3 per cent coots, waterfowl and other water birds in all comprising 2 38 per cent of the total game kill in Ohio, whereas this group of birds in Denmark comprises 54 per cent of the eatable game killed In Ohio there was 0 26 duck shot per hunter, whereas in Denmark there were 5 5 duck shot per hunter, or 22 times more ducks shot per hunter in Denmark than in Ohio

(*c*) *Ohio and Denmark as border areas between North and South*

To some extent Ohio and Denmark occupy similar positions as border areas between north and south, both areas getting a fair share of the northern and southern bird elements Very few of these northern birds, however, breed in Ohio, whereas many breed in Denmark, these species are listed in group 5, p 23

A comprison of the groups of birds listed, pp 20–22, will show how most of the birds in common for Ohio and Denmark are most common in Denmark, and the ones that are not are mostly birds native of the North American Continent and so stragglers to Denmark

Examples of some northern species that breed in Denmark, but only occur occasionally in Ohio, are eider, goosander (Am merganser), goshawk, peregrine falcon, kittiwake, raven, magpie, northern shrike, and red crossbill

Of the birds in common for the two areas, Ohio has the black-crowned night heron as a common breeding bird in suitable habitats, this bird is a southern species, and has only been recorded a few times from Denmark as a straggler from breeding colonies in southern Europe or Africa

Other species, not found in Denmark, add much more to the southern character of Ohio's bird fauna, especially the New World birds hummingbirds, and also the vultures Vultures are found in southern Europe and Africa, from where three species (*Aegypius monachus*, *Gyps fulvus*, and *Neophron percnopterus*) have straggled to Denmark, a total of six individuals having been recorded from the country (Hörring, 1934)

Species, such as many New World warblers, *Parulidæ*, the various *Icteridæ*, tanagers, *Thraupidæ* and others, add still more to the southern characterized bird fauna of Ohio Above all, the ruby-throated hummingbird, *Archilochus colubris*, is the sensation for the ornithologist from a nordic country

The glossy ibis, which in North America breeds in peninsular Florida, and in

Europe in the Lower Danube valley, South Spain and South Russia, has been recorded in both Denmark and Ohio also

(d) *The diversity in landscape, vegetation and land-use in Denmark*

A very important factor for the large number of birds found in Denmark is the diversity of the Danish landscape

Roughly speaking, Ohio consists of the flat western farm land part and the hilly eastern dairy section and southern forest land In addition, the Lake Erie shoreline, rivers, lakes, and ponds add to its varying landscape

In spite of its smallness Denmark shows a more varied type of landscape, including a long sea-shoreline (4,622 miles), a large number of islands in the sea of which 383 are uninhabited, and many of them rocky, long, narrow fjords, a great number of streams, creeks and brooks, ponds and lakes, vast marsh lands, sand-dunes, large closed and open bays, moorlands and heath, great pine and spruce forests in addition to deciduous forests, and farmland with many fencerows and windbreaks

The importance of Denmark's location in the sea has been discussed above

The long sea-shore affords habitat for a variety of birds, on the sand strand itself breed the least tern, semipalmated plover, oyster-catcher and others, on the adjoining strand meadows a great many birds may be found breeding gulls, terns, ducks and shore birds

The islands are often densely populated with birds gulls, terns, ducks and shore birds On rocky islands breed eiders, turnstones, kittiwakes, murres, razor-billed auks and black guillemots Along the fjords are sometimes found strand meadows with suitable habitats for waterfowl and shore birds, and the fjords are often a preferred wintering area for diving ducks, loons and gulls

Ponds and lakes harbor waterfowl and shore birds, marsh lands the same variety of species plus others as various harriers, bitterns and godwits In not too wet marsh lands the short-eared owls occur

The sand-dunes have a very characteristic flora, but bird life is scarce, wheatears, *Oenanthe oenanthe* being one species that commonly is found there, in addition to gulls and terns from the nearby sea

The heath, occupying 7 5 per cent of the total land area, is a very characteristic type of land with a very distinct flora and fauna Birds characteristic of the heath are the golden plover, black grouse, *Lyrurus tetrix*, and wood sandpiper, *Tringa glareola*, in the wetter parts Since 1930 the curlew, *Numenius arquata*, has started breeding in increasing numbers (Westerskov, 1942 a), and seems to take over certain heaths after the plover that has decreased in number

Since about 1870 increased plantings of conifers have been made because of the high prices for softwood These plantings have resulted in a rapid increase in coniferous forest lands Newcomers to these plantations are the crested tit, *Parus cristatus*, which immigrated to Denmark as a breeding bird in the last decade of the 19th century, and since has spread to plantations all over Jutland (Jespersen, 1944), mistle thrush, *Turdus viscivorus*, red crossbill, *Loxia curvirostra*, green woodpecker, Montagu's harrier, *Circus pygargus*, European woodcock, and others (Poulsen, 1947)

Concerning land-use methods, the extensive use of fencerows and windbreaks especially, is of great benefit to the bird life in Denmark The fencerows furnish shelter, nesting sites and food for a great variety of Passerines The influence of fencerows on the number of birds present will be discussed further in another paper

Ohio does not offer the variety of habitats found in Denmark The number of birds found in the farm land section is lower because of lack of fencerows for shelter and nesting sites The intensive farming of vast areas of the same crop does not yield the variety of food and nesting sites as the smaller, often irregular shaped Danish fields

CLOSELY RELATED SPECIES IN ADDITION TO IDENTICAL ONES

In addition to the species, mentioned in Table 2, that have been recorded from both Ohio and Denmark, a number of other birds, very much alike in general appearance, are found in both areas

Many of the species I refer to here are so much alike that they can not be told apart when seen in the field, as e g , the American great blue heron, *Ardea herodias*, and the European common heron, *Ardea cinerea* Others, as e g , the blue jay, *Cyanocitta cristata*, and the European jay, *Garrulus glandarius*, behave and act alike, live in comparable habitats, are shaped alike, and their voices are much alike, but they vary somewhat in size and color

These species, that are listed in Table 3, contribute probably almost as much to the similarity of Ohio and Denmark avifaunas as all of the 99 identical species lumped together Many of the birds of this group are common breeding birds in both areas, whereas only a very few of the identical species, listed in Table 2, do breed commonly in both regions

A matter like this can only be based on a personal estimate of which birds appear alike to the observer The following list is proposed as such a list, with all the limitations such a list may have

TABLE III

CLOSELY RELATED BIRD SPECIES FOUND IN OHIO AND DENMARK

Key symbols as in Table I

OHIO		DENMARK	
NAME	OCCURRENCE	NAME	OCCURRENCE
Great blue heron, *Ardea herodias*	CM NL	Common heron *Ardea cinerea*	CM NC
Am bittern, *Botaurus lentiginosus*	CM NL	Eur bittern *Botaurus stellaris*	NL
Redhead *Nyroca americana*	UM	Pochard *Nyroca ferina*	NLC CM
Sharpshinned hawk *Accipiter velox*	UM RN	Sparrow hawk † *Accipiter nisus*	NC CM
Redtailed hawk *Buteo borealis*	UWRes, RN	Buzzard *Buteo buteo*	NC CM
Bald eagle * *Haliaeetus leucocephalus*	RWRes VRN	Sea eagle *Haliaeetus albicilla*	EN UW
Virginia rail *Rallus limicola*	UM NL	Water rail *Rallus aquaticus*	NL CM
Sora *Porzana carolina*	NL CM	Spotted crake *Porzana porzana*	NL UM
American coot * *Fulica americana*	CM NL	Coot *Fulica atra*	NC CM
Golden plover *Pluvialis dominica*	UM	Golden plover *Pluvialis apricaria*	NL CM
Woodcock *Philohela minor*	UM NL	Woodcock *Scolopax rusticola*	NL CM
Am Avocet * *Recurvirostra americana*	Ca.	Avocet *Recurvirostra avosetta*	NCL
Bonaparte s gull *Larus philadelphia*	CM	Black headed gull *Larus ridibundus*	CW NC CM
Ring billed gull *Larus delawarensis*	CM UWRes	Common gull *Larus canus*	NC CM CW
Great horned owl *Bubo virginianus*	URes	Great horned owl *Bubo bubo*	EN RW
Barred owl *Strix varia*	URes	Tawny owl *Strix aluco*	NC Res
Whip-poor will *Caprimulgus vociferus*	NL CM	Nightjar *Caprimulgus europaeus*	NCL UM
Chimney swift *Chaetura pelagica*	NL CM	Swift *Apus apus*	NC CM
Hairy woodpecker *Dryobates villosus*	CRes	Great spotted woodpecker *Dryobates major*	NC Res
Crow * *Corvus brachyrhynchos*	VCM CN	Crow *Corvus corone*	NC CM CW
Blue jay *Cyanocitta cristata*	CRes	Jay *Garrulus glandarius*	NC CM
Whitebr nuthatch *Sitta carolinensis*	CRes	Nuthatch *Sitta europaea*	NC Res
Wood thrush *Hylocichla mustelina*	CM NL	Song thrush *Turdus ericetorum*	NC CM
Golden-crowned kinglet *Regulus satrapa*	CM UWRes	Goldcrest *Regulus regulus*	NC Res, CM
Eastern phoebe *Sayornis phoebe*	NC CM	Spotted flycatcher *Muscicapa striata*	CN CM
Pine siskin, *Spinus pinus*	UM RWRes	Siskin, *Carduelis spinus*	NL CM CW

*Certain similar American and European species of birds are considered by a group of ornithologists to be races of the same species and could accordingly be listed in Table II These include for example the American bald eagle and European sea eagle coot avocet and crow

† Not to be confused with the American sparrow hawk the Am. kestrel *Falco sparverius*

It is obvious, however, that some other species, found in exactly the same habitats, are more or less alike, even if the difference in size or appearance is so great they do not have much similarity in appearance

These birds, which have what might be called ecological niche similarities, are

Belted kingfisher, *Megaceryle alcyon* in Ohio and kingfisher, *Alcedo atthis*, in Denmark, both living at streams and lakes, having their nests in a burrowed hole in stream banks

Flicker, *Colaptus auratus*, in Ohio and green woodpecker, *Picus viridis*, in Denmark, both mature forest species, much alike in behavior, size, flight and screech

Robin, *Turdus migratorius*, in Ohio and blackbird, *Turdus merula*, in Denmark, both being woods-parks birds, and living in gardens and where possible around human dwellings

Finally two species may be mentioned which live in the same ecological niches, and playing the same role in people's mind as messengers of spring, namely, the Killdeer, *Charadrius vociferus*, in Ohio fields, and the lapwing, *Vanellus vanellus*, of Danish fields Where you look for lapwings in the fields of Denmark, you look for killdeer in Ohio

In order to test my idea about this I asked Dr Daniel L Leedy, of the Ohio Wildlife Research Unit, who served in England during the war, what the counterpart of the killdeer was in England And I got the answer Lapwing

A GENERAL AVIFAUNISTIC COMPARISON

It is difficult to summarize the heterogenous bulk of information given above Certain conclusions may be derived however, concerning similarities in the bird faunas

The two types of habitats where the greatest similarity is found are urban areas and water areas

In cities English sparrows and starlings are as common in Ohio as in Denmark, and during the summer time the swifts are seen over Ohio cities as well as over Danish cities

Lake shores, islands, ponds and streams have, however, the greatest number of similar birds ducks, gulls, terns, shore birds, coots, gallinules, etcetera

Farmlands in both areas have the introduced pheasant and the European partridge, whereas most of the other birds found in the fields are different

Birds of the forests are not much alike, certain birds-of-prey, crows, wrens, kinglets, and others, occur in both areas, some of them in the same species, others belonging to various genera, but yet rather alike

For convenience in comparing the avifaunas of Ohio and Denmark the birds may be grouped as follows

1) Subspecies that are identical and occupying the same ecological niches, and breeding commonly in both areas, as the introduced sparrows and starlings, other species as mallard and bank swallow

2) Species that are alike, but different subspecies, breed in both areas, as the barn swallow, marsh hawk and gallinule

3) Species that are different (yet much alike in appearance), but belonging to the same genus, occupying the same ecological niches, and breeding in both areas, as the great blue heron, coot, and sharpshinned hawk

4) Species that belong to different genera, but yet are so externally alike that they are easily recognized as "identical" when seen in the field, as the woodcock and chimney swift

5) Species that are definitely different in color pattern or size, but which

occupy the same ecological niches, as the belted kingfisher, flicker and robin in Ohio compared to kingfisher, green woodpecker and blackbird in Denmark.

How similar or dissimilar the general bird picture is will best appear from some examples of birds seen at various seasons and in various habitats in the two areas

During a trip to the University woodlot, Ohio State University's farm, on April 6 1947, I saw 21 species of which only two could have been seen on a similar trip in Denmark, namely, English sparrow and starling Species rather similar to Danish species found in similar habitat, were the kestrel, flicker, phoebe and crow

During a trip to the forest at Barrit, Vejle Fjord, Denmark, on April 9, 1944, I saw 24 species of which only the starling could have been found in Ohio, too Species resembling American ones were crow, green woodpecker, great spotted woodpecker, buzzard and sparrow hawk

On a trip to Starve Island, Lake Erie, June 18, 1947, I found five species breeding on the small island, of which the two, common tern and herring gull, breed in similar habitats in Denmark, and two of the others have "relatives" in similar Danish habitat, namely, the black duck and spotted sandpiper

On a trip to the island of Langli in Ho Bugt in Denmark, June 4, 1942 (Westerskov, 1942 b), I observed 15 species of birds of which the 14 were breeding Of these 14 species five could have been found in a similar habitat in Ohio, namely, semipalmated plover, herring gull, common tern, barn swallow, and starling (the last two breeding at the shepherd's house)

These few examples could be supplemented with many more, but they give a little idea about which similar species are seen

The variety in habitats in the Danish archipelago compared with the more homogeneous look of the state of Ohio as a small part of a vast continent affords possibilities for interesting comparisons in faunistic and floristic fields

Further studies and comparisons between regions in various parts of the world are suggested, and might yield unexpected results not only concerning ecological compositions and evolution, but might even render a basis for suggestions in applied phases of ecology, as wildlife management, agriculture and forestry

SUMMARY

In spite of various geographical locations and differences in climate, vegetation, landscape form and land-use, the State of Ohio and the Kingdom of Denmark have a certain degree of similarity in avifaunas, especially concerning the water birds ducks, gulls, terns, etc

Three hundred and forty-three species of birds have been recorded from Ohio, and 334 from Denmark Of these no less than 99 species have been recorded in both areas Sixty-four percent of these are water or wading birds

Most of the birds recorded from both areas are more common in Denmark than in Ohio Of the 46 species breeding in either country, 13 breed in both areas, 8 in Ohio only, and 25 in Denmark only

The main reasons for the proportionately greater number of species in Denmark and greater frequency of those species present are thought to be first, the geographical position of the country as an apex of the European continent, thus being the connecting link (flyway) between western Europe and Fenno-Scandia-Siberia, and affording wintering grounds for many northern birds, especially diving ducks

Second, Denmark is an archipelago consisting of one peninsula and 483 islands, thus getting its share of migrating and wandering around water birds

Third, both areas are more or less intermediate between northern and southern faunas, but Denmark most so

Finally, there is a diversity in vegetation, landscape form and land-use in Denmark not found in Ohio

In addition to identical species occurring in the two areas a number of birds are so much alike that often they cannot be identified in the field Twenty-six such species are listed

Greatest similarity in the avifaunas are found at lakeshores and seashores, and in towns Very few birds of field and forest are the same in the two areas

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STUDIES IN HUMAN INHERITANCE XXXIV
FURTHER DATA ON THE LINKAGE OF THE GENES FOR SICKLE CELLS AND THE M-N BLOOD TYPES

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The demonstration of linkage between human genes has long been an ideal of laboratories of human genetics Many studies have been made along this line, mostly with negative results A few instances of probable linkage have been reported (Penrose, 1935, Haldane, 1936, Burks, 1937, Rife, 1941, Hoogvliet, 1942 Snyder and Palmer, 1943, Kallis and Schweitzer, 1943, Penrose, 1946, Kloepfer, 1946), but these have largely involved either sex-linked characters or variable traits, the exact hereditary nature of which is not known For a comprehensive summary of the linkage studies carried out to date, see Kloepfer, 1946

Recently we presented evidence for the first instance of autosomal linkage involving proved unit factors (Snyder, Russell and Graham, 1947) Both coupling and repulsion phases were demonstrated This discovery was of sufficient importance to warrant the intensive search for more data We have therefore concentrated our attention on the obtaining of families showing the sickle cell trait, in which the sickle cell parent was type MN We have found a number of such families, and some of them are of suitable nature to provide linkage data The additional families uphold the hypothesis that the genes for sickle cells and for the M-N types are linked, and that the gene for sickle cells is transmitted independently of the genes for the A-B groups and the Rh types

The complete data including those of Snyder Russell and Graham, are presented below For the association between sickle cells and the M-N types (Table I), the total score (summation of λ) is seen to be 12 72 with a variance (summation of K) of 21 026 Since the total score exceeds 2 33 times the square root of the variance (12 72 exceeds 10 69), the evidence against the hypothesis of random assortment is significant at the one percent level

TABLE I

Linkage Data on the Genes for Sickle Cells and the M N Blood Types

Finney Type	Family Number	a	b	c	d	γ	K
3	30	2	0	0	0	1 00	1 000
4	7	3	0	0	1	6 00	6 000
4	8	1	0	0	2	3 00	3 000
4	11	1	2	1	0	0 00	6 000
4	17	0	1	0	1	—1 00	1 000
18	37	1	1	1	0	—0 11	0 549
18	38	1	0	4	1	—0 78	1 987
18	39	3	0	0	1	3 83	0 941
18	40	0	1	2	0	0 78	0 549
						12 72	21 026

The crossover percentage (c) may be estimated from the formula $c = \frac{1}{2}\left(1-\sqrt{\frac{\Sigma\lambda}{\Sigma K}}\right)$, which gives a value of 0 111

For the record, the corresponding tables for the A-B blood groups and the Rh types are also presented (Tables II and III), indicating the independent transmission of these genes and the gene for sickle cells In neither case does the total score even approach the square root of the variance

Finney's modifications of Fisher's methods were used throughout the analyses (Finney, 1940)

TABLE II

LINKAGE DATA ON THE GENES FOR SICKLE CELLS AND THE A B BLOOD GROUPS

Finney Type	Family Number	a	b	c	d	γ	k
5	1	1	1	1	2	—2 000	10 000
5	15	1	1	0	0	—1 000	1 000
5	20	2	1	1	2	—1 000	15 000
5	30	1	1	0	0	- 1 000	1 000
5	34	2	0	2	0	—2 000	6 000
5	35	1	1	2	1	—2 000	10 000
6	16	1	1	0	0	—0 333	0 238
7	36	0	0	2	2	—0 222	1 333
7	37	1	0	1	1	—0 111	0 778
7	38	2	0	3	1	—0 500	2 778
7	39	1	0	2	1	—8 444	1 333
						—18 610	49 460

TABLE III

LINKAGE DATA ON THE GENES FOR SICKLE CELLS AND THE RH BLOOD TYPES

Finney Type	Family Number	a	b	c	d	γ	K
5	5	1	0	1	2	0 000	6 000
5	6	0	1	1	0	1 000	3 000
5	10	1	1	0	0	—1 000	1 000
5	12	3	0	1	0	0 000	6 000
5	30	1	1	0	0	—1 000	1 000
6	8	1	0	0	2	1 666	0 549
6	16	1	0	1	0	—0 111	0 238
7	38	3	1	2	0	—0 555	2 778
7	39	1	2	0	1	—1 333	1 333
7	40	2	0	0	1	0 778	0 778
8	36	1	1	1	1	—1 037	0 836
						—1 502	23 512

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THE INFLUENCE OF GEOLOGY IN OHIO PLACE-NAMES

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Except for those of Indian origin, surprisingly few place-names in Ohio sprang from that most direct manner of choosing a name—the geography, geology, or environment of the locality The Indian, having little tradition or historical ties in his background, selected his names from appearances, and usually with an association, sometimes general, sometimes pointed, to surroundings The Indian word from which *Ohio* was derived is said to have meant "beautiful river" Sandusky was named for its cold streams, the Tuscarawas for "wide mouth" Hocking signified "the gourd" or "the bottle" because of the resemblance, in the rock basin and spillway at its edge, at Rock Mill The Indian's name for Mt Pleasant at Lancaster was "The Standingstone", a choice certainly far more vivid than the present designation

It is almost impossible to trace Indian names to their derivation because of dialects involved, and because to white men who tried to record them, the originals were full of strange consonants and misleading gutterals As a result, Indian names were handled roughly as they went through French and then English translations, and they were even more severely dealt with by early cartographers who received them orally from explorers and soldiers Occasional names took a form that made their source uncertain—they may equally well have been Indian or French or English Chagrin is such a word According to the well-known account, it was given by Moses Cleaveland in 1796 when he and the exploring group he led mistook the Chagrin River for the Cuyahoga, and when, upon discovering their error, Cleaveland chose the particular name because it expressed the emotional reaction of his party Bearing in mind that this is a region where other large streams have names of French origin—Grand, Roche (now Rocky) and Vermilion—and the fact that the word "chagrin" seems strangely out of character, there is reasonable ground for being dubious as to the story On Rufus Putnam's map of January, 1804, the river is shown as *Shaguin*, and in early histories the name has been given as *Shagrin*, supposedly meaning, in local Indian dialect, "clear" Finally, to confuse the matter further, Saguin's Post, or French Town, is said to have been located a few miles away on the Cuyahoga in what is now Brooklyn Township

While English-speaking people had little patience with Indian place-names, the French were careful to preserve them even though many of the originals were translated and preserved in the French form Perhaps it is for the same reason that French on a menu is more enticing than English, nevertheless the fact is that French geographic names have an imagery and originality that is rarely equalled in English Who wouldn't prefer Baton Rouge to Red Stick, or even to Red Cypress, for which, because of the abundant cypress trees, the place was evidently named? Or where is the childlike idiom of the Indian better preserved than in the name Trempealeau? That huge rock hill, an island in the Mississippi, the Indian called "The Mountain Soaking in the Water", the French equivalent, "La montagne qui trempe a l'eau" is descriptive poetry too rarely found in geographic names

The origin of a geographic name is frequently difficult to trace because of outright changes Even more difficulty results from modifications and distortions which some names underwent Throughout the United States, any number of towns, rivers and lakes bear names entirely different than their originals, changes sometimes made by natives who had a struggle with the original spelling, sometimes (for the same reason, apparently) by the Post Office Department or the Board on

Geographic Names, and frequently with little credit to whatever person or agency was responsible For English-speaking people had as little patience with French names as with Indian! In southern Arkansas, in a region with a liberal scattering of names of French origin, is the oil town, Smackover Originally it was a trail, arched over by spreading trees, and the French named it the "covered way", or Chemin Couvert Now, Chemin Couvert was hard to say and harder to spell, so it became something sensible—first, Smack Cover, and then Smack Over At the foot of the Gros Ventre mountains—a name, by the way, for the anatomical development of a particular tribe of Indians—is the town in Wyoming with the telescoped name *Grovont* In northern Michigan, the island Bois Blanc, named for the white birches, is known as Bob Lo, and in Missouri, Bois Brulé, meaning "burned woods", is *Bob Ruley* Simplification is not alone to blame for ridiculous changes, for some resulted from such things as attempts at euphemism and polite speech A few miles west of the Muskingum County line, on Route 40, is Buzzard Glory Knob, re-styled some years ago Crow's Nest—a change involving a contradiction of natural fact, and a substitution of the commonplace for a name that was bright with color and melody and motion

Those who named early settlements believed as zealously as the father of Tristram Shandy in the destiny of a name, consequently many that were chosen were deliberately stilted It has been said that Ohio is surpassed only by Pennsylvania (1) in the number of classical geographic names Xenia, Gallipolis, and Akron (the last, it might be said, of geological origin) are a few of Ohio's classical names Local color in the choice of a name was probably regarded as a handicap to future development For many reasons, therefore, geological names are in the minority in Ohio Where they can be found, they represent obscure and sometimes forgotten places, and often they have a narrow and frequently trivial application

NAMES BASED ON WATER SUPPLY

One category into which geologic place-names are grouped is based on the source and nature of the water supply The largest Ohio city so named, though from the frequency elsewhere it might be assumed to have been a "transferred" name, is Springfield The first settler in Springfield was James Demint, who arrived in 1799 The site was surveyed in 1801 by John Daugherty, and the following year Simon Kenton moved to what is now West Springfield The name Springfield was chosen by Mrs Kenton because of the many springs along the cliffs of Buck Creek Springboro, in northern Warren County, the site of a spring which is said by Fuller (2) to be one of the largest in southwestern Ohio, issues from thick drift deposits Yellow Springs, in Greene County—particularly the largest spring which gave the place its name—flows from the Springfield limestone, and is so charged with calcium carbonate that it has built large deposits of travertine at the surface The iron carbonate "chalybeate" water has given the deposits a definite rust-yellow color At Green Springs, on the Seneca-Sandusky County line, a number of springs (3) come from the Tymochtee limestone One of these discharges 8 million gallons per day, and was so prized by the Seneca Indians that, when the white man was about to take over the spring in 1814, the Indians attempted to choke off its flow by filling the basin with rocks and logs

Two villages were given more descriptive names Sinking Spring, in Adams County, was named for a small flow which, after emerging from Niagaran limestone, disappears underground in joints of eastward-dipping rocks In Ross County is Spout Spring, now known as Humboldt, an artesian-like discharge from the contact of the Ohio shale and the underlying limestone, which at one time spouted water from a hollow log driven horizontally into the crevice

The town adjacent to the largest spring in northern Ohio was given a classical name—Castalia Water from nearby Blue Hole in a volume of approximately 7 million gallons per day is responsible for the name of Cold Creek, and also the

Indian "Sandusky", which had the same meaning Another city with a classical, and probably the most musical name in Ohio, is Bellefontaine, so called because of the numerous springs from the limestone outlier and glacial gravels around it

NAMES FROM MINERAL RESOURCES

Mineral resources have been the basis for most of Ohio's geological place-names, and, as might be expected, coal leads all others The first coal used in Cleveland (4) and on Lake Erie was shipped over the then new Ohio canal in 1828, and came from Coal Hill in Tallmadge Township, Summit County, from a mine owned by Henry Newberry, the father of J S Newberry the geologist Coalburg, in the southeast corner of Trumbull County, furnished one of the first iron-making coals to be used anywhere This was the Sharon coal, and because it could be used without first coking, it gave the Youngstown area an early impetus in the iron industry In Weathersfield Township, Trumbull County, the Sharon coal and associated Black Band ore gave the name to Mineral Ridge The iron ore known as "American Scotch" was mined under the ridge and was once important in the industry throughout the entire Mahoning valley In Athens County, two mining towns were named from the Middle Kittanning coal—Carbondale and Mineral, both in Waterloo Township Coalton, in Jackson County, was the site of coal operations as early as 1878 in the Quakertown coal Cannelville, in Brush Creek Township, Muskingum County, was named for the cannel[1] characteristics of the upper part of the Upper Freeport coal, though the Middle Kittanning was later the important bed there In Waterford Township, Washington County, the Meigs Creek coal is mined in the vicinity of Coal Run At Minerton, in Vinton County, the Clarion Coal and Vanport limestone were once important In the same county, the Ferriferous ore was formerly mined by stripping at Oreton, and was used extensively in the iron industry then flourishing in southern Ohio

At Ironton, the Ferriferous limestone was used as a flux for the iron ore lying immediately above it, and together they made the name Ironton famous for its furnaces There have been two Galenas in Ohio—the present one in Delaware County was first known as Zoar when founded in the spring of 1816 The other, in northwestern Scioto County, is now called Rarden Lead being practically unknown in rocks in Ohio, there is no good basis for the mineral origin of the names The Sunbury shale in the first instance, and the Ohio shale in the second contain many scattered nuggets of pyrite though "Fools Gold" would never do for a town

The flinty phase of the Vanport limestone is responsible for the name Flint Ridge, in Licking and Muskingum Counties At Glass Rock, Perry County, the Sharon conglomerate has been quarried and the product shipped for many years for the manufacture of glass In Lucas County, the Sylvania sandstone (5) has been quarried since 1863 at Silica, from which point the sand has been shipped to such centers as Pittsburgh for glassmaking In the vicinity of Sandusky Bay, rock gypsum was discovered (6) in the upper part of the Monroe series in 1821, and the town of Gypsum is today a center for quarrying the mineral Green Island in Lake Erie, southwest of Put-In-Bay, was formerly called Strontian Island for the crystals of celestite (strontium sulphate) so well developed in cavities in the dolomite In Lake County, the plant of the Diamond Alkali Company, where chemical brine is produced from the Salina series, is located at Alkali

Salineville, in southwestern Columbiana County, was the site of salt springs and later salt wells, the first of the wells being drilled in 1809, with about twenty producing by 1835, and the last one abandoned in 1880 There are at least three Salt Creeks in Ohio, all once having salt springs along their banks The one in

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[1] A coal formed largely from plant spores and pollen The name seems to have been a corruption of *candle*, given to the coal because of the ease with which it ignites and the yellow, luminous flame when burning

Holmes County, flowing into Killbuck Creek, attracted settlers as early as 1809 Putnam's map of 1804 shows salt springs on both the Salt Creek which flows into the Muskingum below Duncan's Falls and the one entering the Scioto in the southeast corner of Ross County

At White Sulphur, 5 miles southwest of Delaware, the saline sulphur springs were at one time better known than they are now When the water of the springs was evaporated, a white residue of sodium chloride and other salts remained, once supposed to be sulphur From the Ohio shale along the banks, the efflorescence of the mineral melanterite or copperas, improperly called alum because of its white color and astringent taste, gave the name to (7) Alum Creek Along the narrows of Paint Creek in Ross County, the same mineral on the walls of Ohio shale was responsible for the gorge being called Alum Cliffs A short distance west, the fantastic bluff of under-cut shale is known as Copperas Mountain In each case, the melanterite was produced through the action of ground water and oxidation of iron sulphide in the shale

On the Ohio River, 5 miles below Marietta, is Gravel Bank This outwash deposit lies about 100 feet above present stream level, and in the early days of railroad building (8) furnished more ballast and railroad gravel than any other source in southern Ohio About ten miles above Marietta, Rainbow Creek enters the Muskingum from the west Seepages of oil from shallow outcrops and leakage from early wells left iridescent filmy patches on the stream Hence, from the varicolored hues on the water, the terms Rainbow Creek and the name of the village Rainbow

STRATIGRAPHIC NAMES

Some geographic names originated in connection with local stratigraphy The Columbus limestone, because of its crystalline nature and the fact that it polished well, was once thought to resemble marble, and so we have Marble Cliff on the west bank of the Scioto at Columbus Along the Muskingum River south of Zanesville, prominent cliffs are formed by a coarse sandstone, the Cow Run In many places the rock is covered with lichens, and where it is moist the surface is a definite blue-green The town on the river at the foot of the rock bluffs is Blue Rock In southwestern Ohio, on the Greene-Clark county line, the Little Miami river drops over the Niagara escarpment, formed by the outcrop of the Springfield and Cedarville limestones, at the village of Clifton In Lawrence County, sandstone cliffs in which the Clarion sandstone is prominent overhang "like the cornice of a house" at Hanging Rock.

Rockville was located on the Ohio River at the east line of Adams County As early as 1814, the Buena Vista sandstone of the Cuyahoga was quarried here, and in 1831 the rock for the Ohio River locks at Cincinnati was taken from these quarries Starting about 1840, a lower ledge was much used in buildings in Cincinnati and was known as the "City Ledge" The rock was also used in buildings in Pittsburgh, Detroit, Chicago, and other cities Another Rockville located north of Greenfield in Fayette County, on the outcrop of the Monroe, is now known as Rock Mills Berea sandstone was quarried in the nineties at Stoneville, in the southwest corner of Ashtabula County Rockbridge in Hocking County is named for the near-by natural bridge in the Black Hand sandstone An important source of building stone was at Freestone in Scioto County, where sandstone layers of the Cuyahoga were worked and shipped to points as far away as Baltimore, Chicago, Alberta and New Orleans

Mt Gilead was originally settled as Whetstone, where Whetstone Creek crosses the outcrop of one of the country's finest natural abrasives, the Berea Grit In the northeast corner of Seneca County is the town Flat Rock, where the Delaware limestone, lying in thin layers with little soil cover, is on the surface Flat Rock

Creek is in Paulding County, and was probably named for the thin, plate-like slabs of Tymochtee limestone in its bed

There are any number of Slate Runs in Ohio, the largest in Huron County, tributary to the west branch of the Huron River From Siam to Monroeville, Slate Run crosses the Ohio shale Slate Mills in Ross County is on the north fork of Paint Creek at the outcrop of the Ohio shale

A short distance beyond the southeast corner of Franklin County is Lithopolis, where the Berea and Cuyahoga outcrop and where the latter sandstone was once quarried for window sills and caps From the Greek for "stone" and "city," Lithopolis is by coincidence a fitting name for the place of birth of a dictionary publisher

ALTITUDE AND NAMES

There are localities, too, named for their elevation At the time of the organization of Highland County in 1805, the county seat, Hillsboro, was thought to be the highest point in Ohio Because of the elevation of the country about it, the county was called Highland The name of Belmont County was for the beauty of the montaine topography Altitude, a few miles east of Woodsfield in Monroe County, is perched at an elevation of 1210 feet, about 400 feet above Sunfish Creek, which flows in the adjacent trenched gorge The divide between Lake Erie and the Ohio River extends diagonally across the southern part of Summit County, and this being the highest area traversed by the Ohio Canal, the county was named Summit when founded in 1840 Akron, for the Greek "high", was the name given the county seat Many names of this kind are those of railroad towns On the D T and I, in southeast Ross County, is Summithill, at the crest of one of the steepest railroad grades in Ohio In a series of spectacular bends and turns the railroad climbs from an elevation of 723 feet at Bainbridge to 1085 at Summithill, and descends to 572 feet at Waverly Crestline, in Crawford County, was originally known as Livingston when the Cleveland, Cincinnati, Chicago and Indianapolis railroad was built in 1850 When, in 1852, the Pennsylvania railroad reached the village, a new town was begun This was called Crestline, and when the towns merged, the name Livingston disappeared Crestline lies between the northeast extension of the Broadway and Powell moraines at about 1170 feet elevation and it is said that it too, was at one time thought to be one of the high points in the State

On the northern boundary of Wayne County, and on the Allegheny escarpment, is Creston—likewise a railroad town, the elevation of which is about 1000 feet On the Logan-Hardin county line, and on the St John's-Mt Victory moraine, is Ridgeway Two divisions of the New York Central cross here at an elevation of about 1060 feet

Although there are many "mountains" in Ohio having specific names, one of them should be mentioned because of its geographic prominence Little Mountain is on the Lake-Geauga county line, about 7 miles northwest of Chardon This knob, capped by Sharon conglomerate, lies on the Portage escarpment From its summit of nearly 1300 feet elevation, overlooking to the north the beaches of Lakes Maumee, Whittlesey and Warren, and with Lake Erie in the distance, the view (9) from Little Mountain is one of the most impressive in Ohio

PHYSIOGRAPHIC NAMES

Some localities were named for their physiographic setting Plain City, in Madison County, is located on the "Darby Plains", a portion of the flat Wisconsin ground moraine Prairie Depot, Wood County, is on the monotonous "black swamp" of Lake Warren Belpre, in Washington County on the flood plain of the Ohio River, has a name of French origin meaning "fine meadowland" South

Point, on the Ohio in Lawrence County, is very near the southernmost point in Ohio, and bears a name which is geographic rather than geologic Moraine City, now a part of Dayton, lies on the dissected Bloomington moraine of the Wisconsin drift sheet

In Ottawa County, a resistant ridge cf Guelph dolomite is called Rocky Ridge, and in Henry County, a village on the beach ridge of Lake Whittlesey is known as Ridgeville Corners On an old shore line south of Conneaut in Ashtabula County is South Ridge, and in Lorain County, North Ridgeville is located on the beach ridge of Lake Warren, the northernmost of three old shore lines

In Fairfield County, the topographic map shows Slough, a small community a short distance east of Lithopolis A few hundred yards west of Slough is a marshy area (10) of glacial lacustrine deposit, the result of a northward-flowing stream being blocked by Wisconsin ice and the recessional moraine the ice left

In Boston Township, Summit County, is the village of Peninsula The town antedates the railroad, which was not built until 1873, but the Ohio Canal, following the Cuyahoga at this point, had been completed in the early 1820's From the river and the canal, the steep bluff, capped by Sharon conglomerate, juts into the stream in a narrow promontory so that even though far inland, to a "canawler" this was indeed a "peninsula"

NAMES INDIRECTLY RELATED TO GEOLOGY

There are certain geographic names derived from the manner in which the local rocks affected the scenery or impressed the observer Yellow Creek, in Jefferson County, was so called because of its iron-charged water coming from drainage at the level of coal beds Iron-depositing bacteria and algae coated every rock and pebble and assisted to give the stream channel its bright color Another Yellow Creek enters the Mahoning River at Poland The Black River in Lorain County was probably named from the gloom of its deep valley, resulting from both the black Ohio shale and the heavy foliage along the steep valley walls Rocky River cuts through rocks extending from the Chagrin to the Cuyahoga, and because of its steep gradient, the stream has swept away smaller fragments but has left its channel strewn with the large pieces of rock debris The Vermilion River was named for the brick-red color resulting where the Ohio shale had been exposed to fire The burned shale was used by the Indians for red pigment The name Paint Creek, west of Chillicothe, was in all likelihood given for the same reason

Because of the fact that early names were not recorded, it is possible that many may have had a geological origin In times when the transmission of a word was oral and not written, when few of the early transients or residents were expert spellers, and when, particularly, French words and Indian dialects were involved, it is surprising that original forms have been preserved at all Undoubtedly, many place-names have been altered in adapting them to English When Anthony Wayne was in northwestern Ohio, a journal (11) was kept for him by one Lieutenant Boyer through which, repeatedly, the river Auglaize is written *Oglaise* The word Auglaize is said by many authorities to have been Indian and to have meant "fallen timber" The word looks and sounds French, however, and it might be noted that forms such as Au, Aux, Eau and other variants, all applied to streams, are found throughout the world in regions traversed or settled by the French Lieutenant Boyer's phonetic "O" suggests, especially with the spelling "Au", a French origin The Auglaize is a larger stream than is sometimes supposed—it is exceeded in drainage area, in fact, by but five Ohio rivers—yet is has one of the lowest gradients in the State With its low gradient and its leisurely flow, the mirrored surface of its waters may have been the reason for the second syllable of the name

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THE OHIO JOURNAL OF SCIENCE

Vol XLIX MARCH, 1949 No 2

CZECHO-SLOVAKIA — THE BRIDGE BETWEEN EAST AND WEST[1]

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Recently the attention of the world was focused on Czecho-Slovakia because of the communist *coup d'etat* there and she still is in the news Most people know very little about Czecho-Slovakia and therefore draw wrong conclusions Having lived there for 25 years I feel able to discuss the geopolitical, economic, cultural, and military implications of the communist *coup d'etat* in Czecho-Slovakia in a more competent way

1 The Geopolitical Implications

Czecho-Slovakia, about 600 miles long and 100 miles wide, lies in the heart of Europe bordered by Germany in the west, Russia in the east, Poland in the north and Austria and Hungary in the south A rather precarious position The *coup d etat* means a consolidation of the Pan-Slavistic space and a further advance of the Russian sphere of influence towards the West Russia's one party system was copied when the Social-Democratic Party was absorbed by the Communist Party and the entire government adopted a single list of candidates for the May elections Dr Benes resigned in June Com Gottwald took over the presidency

Czecho-Slovakia is somewhat larger than Ohio (Cz area 49,358 square miles, Ohio's 41,222 square miles), but her population is more than twice as large (Cz population 14,447,000, Ohio's 6,907,612) This discrepancy is another basic reason for the Czech troubles In addition there are two extensive mountain systems the Carpathian in the eastern part of Moravia, Slovakia and Carpathian Russinia and the Sudeten in the western parts of Moravia, Bohemia and Silesia, leaving only about 35% of the country's area for farming But intensive agriculture still is the predominant occupation claiming about 40% of the population, especially in the east Wheat, rye, barley, oats, potatoes, sugar beets, corn and hops are grown in abundance After World War I the number of peasants was greatly increased by the sequestration of all large estates formerly owned by the Austrian aristocracy and by the land reform for the benefit of Czech legionnaires This trend continued after World War II after the expulsion of the Sudeten Germans and now is in full swing with regard to all other estates and foreign-owned land Only small-scale farms up to 120 acres a family, are permitted to remain in private hands This land reform may be politically expedient, but it is not economically sound because it means a split-up of well established argicultural units and higher operational expenses to the new units

Czech mineral wealth is great and comprises both soft and hard coal, iron, graphite, garnets, uranium, silver, copper, lead, and rock salt On October 24,

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[1] Paper presented before the Geography Section of the Ohio Academy of Science at the annual meeting held at the University of Toledo on May 7, 1948

1945, all mines were nationalized and now they are called "national enterprises" (narodni podniky)

The famous subterranean caverns, lakes, ice caves, labyrinths, etc , as well as the Czech pass and mineral springs used to attract many American, British, French, etc , tourists who may prefer to stay home now

2 The Economic Implications

Minister of Industry, Fierlinger, estimated last month that under the nationalization decrees already legalized by the Czech Parliament, 90% of Czechoslovak industry is in the hands of the state The law provides for state ownership of all export and import, commercial banks, insurance companies, public utilities, defense industries, steel plants, the Bata shoe factories, manufacturing concerns of drugs and phonograph records, glass and chemical industries, paper industries, spinning and weaving mills, clothing factories, hotels, wholesale trade, printing establishments (except small outfits not using rotary presses or similar equipment) and of every other establishment employing more than 50 persons It means that the great majority of Czechs and Slovaks not on farms will have to work for the state or state enterprises At the same time, the government inaugurated a large-scale program designed both to reorganize industrial units into more effective combinations and to concentrate production in the most technically competent areas [2]

To wipe out deficits of the nationalized industries the government adopted October 28, 1946, a Two-Year Plan The overall goal is to raise production of both capital and consumer goods 10% above 1938 by the end of 1948 To this end the government is spending $1,397,000,000 in all phases of Czechoslovak economy [3]

This planned industrialization of Czecho-Slovakia is closely linked to a similar planning in Poland In July, 1947, the two countries signed a five-year trade treaty This treaty provides for extensive development of communications and transport between the two countries and "regulated relations" between their respective industrial and agricultural systems A bilateral Council of Economic Collaboration was set up and trade exchanges planned for the period July 1, 1947, to July 30, 1948 [4]

The only effect the communist *coup d'etat* has on foreign trade is the complete nationalization of all foreign trade [5]

The Czecho-Slovak economy is dependent on foreign trade both as an outlet for the products of industry and for supplies of raw materials Before the war 75% of exports were finished goods and more than 50% of imports were raw materials Postwar trade is following a similar pattern

By value the principal imports are raw cotton, wool, iron and other metallic ores, mineral oils, and chemicals Principal exports are iron and steel products, machinery, textiles, glass, timber, pulp, and paper

Principal imports from the United States before World War II were cotton, fruits and nuts, machinery, copper, and petroleum Principal exports to the United States were textile fabrics and products, leather wares, glass and glassware, malt and hops, and wood pulp

Total trade during 1946 amounted to about 24 5 billion crowns (490 million dollars), of which imports totaled 10 2 billion crowns (204 million dollars) and exports totaled 14 3 billion crowns (286 million dollars) The trade picture with the United States is very dark—in 1947 there was a deficit of imports over exports of 1 9 billion crowns (38 million dollars) Russia's challenge to the United States,

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[2] Foreign Policy Reports, (April 1, 1948), Vol 24, p 19

[3] Current History, (November, 1947), Vol 13, p 272

[4] Foreign Policy Reports, (April 1 1948), Vol 24 p 20

[5] New York Times (March 7, 1948), Gregor Speech, p 10

Great Britain, etc , is that of a country which, because of its boundless need for all kinds of products after the wartime destruction suffered, offers a huge market for the exports of other nations In this respect, Russia has and may continue to have a greater power of attraction for the countries of Central and Eastern Europe and the Balkans than the United States, which has been more concerned in increasing its own exports than in encouraging imports from actual or potential customers Like other countries of Central and Eastern Europe, Czecho-Slovakia has conducted its foreign trade since World War II mainly on the basis of short-term bilateral barter agreements subject to renewal By April, 1948, Czecho-Slovakia had such agreements with 25 countries in the East and West, but had not yet completed a trade agreement with the United States Despite its present dependence on bilateral agreements, Czecho-Slovakia has constantly professed a desire ultimately to return to a system of multilateral trade proposed by the United States, once conditions are favorable to such a development She has participated in the European Economic Commission as well as in the negotiations for the Trade and Tariff Agreement of October 31, 1947, and signed the Charter of the International Trade Organization on April 2, 1948, i e , after the communist *coup d'etat* Russia did not sign it In May, 1948, the U S granted Czecho-Slovakia the tariff concessions in accordance with the agreement of October 31, 1947

The official rate of the Czech crown is 50 crowns to one U S dollar Recently the black market rate rose from 150 to 340 crowns to the dollar This development indicates less confidence in the Czech crowns and a considerable increase in the desire for U S dollars

3 THE CULTURAL IMPLICATIONS

The Czech government is pledged to maintain "practical" cultural relations with the Soviet Union The Czech Minister of Education is a communist He removed Rector Karel Englis, internationally famed economist and ex-minister of finance, from the presidency of the Charles University of Prague—now 600 years old—and Bohumil Bydzovsky, leftist mathematician, is rector of the university of Prague now Since the Communist coup, "action committees" have taken control of the university More than 200 students have been expelled, though 25 U S students still study there (the 22 who are veterans have been cut off G I Bill of Rights benefits) Before they take final exams, all students will have to qualify for "certificates of national and political reliability "[6] All these things have not changed the University of Prague nor Bohemia as places of Western culture People use Western expressions Many streets and squares are named after American presidents It was not possible for the Hapsburgs and Hitler to digest Czecho-Slovakia, it will not be possible for Stalin to enslave the Czech people

4 THE MILITARY IMPLICATIONS

The military potential of the Russian sphere of influence was strengthened by the Communist *coup d'etat* in Czecho-Slovakia, because the cities Prague, Stara Boleslav, Lazne Belohrad, Benesov u Prahy, Boskovice, Brno, Ceske Budejovice, Nemecky Brod, Frenstat, Mistek, Hodonin, Velke Mezerici, Humpolec, Vysoke Myto, Hostivice, Jihlava, Jaromer, Jinec, Jicin, Josefov, Mlada Boleslav, Hrebeny, Kladno, Klatovy, Hradec Kralove, Kolin, Kralupy, Louny, Lobnik, Moravska Ostrava, Hranice, Milovice, Jindrichuv Hradec, Nove Mesto n Mor , Olomouc, Pardubice, Pribramy, Pelhrimov, Plzen, Pisek, Prelouc, Prerov, Prostejov, Psikosice, Rakovnik, Slany, Susice, Sedlcany, Strasice, Tabor, Domazlice, Telc, Trebic, Vyskow, Vsetin, etc , have training areas and other military installations Czecho-Slovakia has eleven ammunition factories, including the famous Skoda Works, twelve transmitters and 8,262 miles of rails, all of it hardly damaged in World War II The Czech Army has 160,000 men—Russia allotted $152,000,000 for it in her last budget Universal military service for all men between 20 and 50 years of age was re-established in 1940 with service for two years Hitler turned the Army into a labor corps, but now it is re-established Czecho-Slovakia signed several military assistance pacts with her neighbors, the last one with Bulgaria It is primarily because of Czecho-Slovakia's fear of a restored strong Germany that the Soviet alliance is regarded by all existing parties as the proper foundation of the nation's military policy

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[6] Time April 19 1948 p 23

CONCLUSIONS

Czecho-Slovakia has to maintain military, political, economic and cultural relations with the Soviet Union Her dependence on Russia for her economic and military security, however, does not exclude agreements with countries outside the Soviet sphere Czecho-Slovakia signed the Trade and Tariff Agreement of October 31, 1947, and the Charter of the International Trade Organization on April 2, 1948, after the Communist coup although Russia did not sign them

Czecho-Slovakia should remain the bridge that connects East with West and not become the bridge which could be used by the troops of both for mutual destruction

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Ecology and Linkage versus Gene Infiltration

Every breeder amateur or scientist, who ever attempted to shift the desirable characters of one kind of plant or animal over into another kind of plant or animal had to practise introgressive hybridization Introgression was originally defined as the gradual infiltration of the germplasm of one species into that of another species As a phenomenon however, introgression may occur across any taxonomic boundary so long as hybridization followed by repeated backcrossing is possible Thus introgression occurs in nature as well as the breeder s experiments It has therefore played a role in evolution, unevaluated as yet by enriching the genetic variability of the participating entities The effects of genteic linkage in restricting both the types and the frequencies of gene recombinations to a 'recombination spindle' foster introgression of genes in groups rather than one at a time Consequently, by careful study of a hybrid population and one of its parent populations it should be possible to detect a group of characteristics which are introgressing from the other unknown parent population Once this group of characteristics becomes specified it constitutes a critical taxonomic description, even though the unknown parent population has never been seen Introgression takes place in direct relation to the degree of survival of hybrid segregates Thus its most rapid pace occurs under human husbandry by a breeder Cultivated plants and weeds are man's respectively conscious and unconscious products of introgression In nature its rate is greatest where the habitat has been disturbed It is here that new ecological niches are available to the new gene recombinations constituted in the hybrid segregates As the previous ecological balance becomes restored, those recombinations most like the original parents will be the ones most likely to survive Thus only a few genes will introgress at a time even under the most favorable natural conditions Introgression is considered to be of greater fundamental biological significance the more gradual and imperceptible it is

These concepts began developing in Dr Anderson's mind some 15 years ago Studies of natural populations in the field since then have verified all the gross aspects of his ideas Refinements in technique are still desired —*Elton F Paddock*

Introgressive Hybridization, by Edgar Anderson 109 pages New York, John Wiley & Sons, Inc. 1949 $3 00

A CHAPTER OF EARLY OHIO NATURAL HISTORY[1]

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INTRODUCTION

In his *History of the Northern American Indians*, a manuscript probably written expressly for the use of Bishop George Henry Loskiel "to aid him in the preparation of his valuable *History of the Mission of the United Brethren among the Indians of North America*" (1), David Zeisberger left to posterity a treasure trove of observation not only on the contemporary Indians, on their life habits inside and outside of the Moravian mission communities, their political institutions, sociology, and religion, but also on the natural environment in which these living conditions had been formed and continued He also showed the intelligent concern of the true historian about the interaction of Man and the forces of nature surrounding him, within a given region The editors of Zeisberger's work correctly remarked (2) that the title, *History of the Northern American Indians*, was not given to the manuscript by its author, but by Bishop Edmund de Schweinitz, Zeisberger's biographer Zeisberger, "had he named it, would probably have called it Notes on the History, Life, Manners, and Customs of the Indians"

It is to be regretted that Zeisberger did not himself cast these raw materials into a mould of true history writing, shaped by the same sound judgment as had guided him in the assembling of his notes for the use of a man who, as far as historic vision is concerned, was by far his inferior Evidently Loskiel did not perceive, in Zeisberger's work, the spark of genius that makes it so different from the general run of historiography of the period

There is, in Zeisberger's entire era, only one contemporary writer who, like him, conceived of history as the product of ethnologic inheritance and geographic environment Justus Möser (1720–1794), a Westphalian author, by profession a jurist, in his *Osnabrückische Geschichte* (3), a history of the city of Osnabruck The introduction to this book, in which he developed his ideas of historiography, was separately published in 1773, by Herder and Goethe in their collection of essays, entitled *Fliegende Blätter von deutscher Art und Kunst*, as one of the clarion calls of the *Sturm und Drang* movement which heralded in both German Classicism and Romanticism It is to be doubted whether Zeisberger ever heard of Möser, yet there is an undeniable similarity in the two men's basic notion of history and, hence, in their approach to their subject

As far as I know, Möser's *History of Osnabrück* is the first attempt ever made at the writing of history on the basis of regional geography Zeisberger intended the very same thing That is clearly evident from the materials which he collected as essential for the use of the historiographer, as well as from frequent inner connections which he points out, in these notes, between the natural scene and the behavior of the people that inhabit it Due to its very nature and purpose, there is absent, in Zeisberger's work, the well planned outer form which characterizes Möser's book, yet, by virtue of his clearly realized ideas on worthwhile historiography and its methods, Zeisberger is fully the equal of Möser

Like Möser, who had chosen his native city of Osnabrück as a typical region for his study of the specific physiognomy of Westphalia and its history, Zeisberger focused his observations on a locality which not only did he intimately know, but which also he considered singularly representative as an area of contact between the aboriginal American scene and the superimposed foreign culture of the Moravian mission system It was the Tuscarawas valley and, in particular, the mission community of Schönbrunn, which he had founded and where he worked from 1772 to 1777

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[1] This article forms part of the research done by Dr Mahr for The Ohio State Archaeological and Historical Society in connection with the restoration of the Moravian Mission town of Schönbrunn The Society contemplates a detailed publication of these studies when completed

In the following pages the attempt has been made to present Zeisberger's regional materials of the Schönbrunn area in such a way as to do justice to his basic idea

(I) THE FORESTS

Zeisberger (4) gives the following general description of the forests of the Tuscarawas region

> ' The forests contain mainly oak trees, other kinds of trees are, however, also found They are not dense, but generally sufficiently open to allow comfortable passage on foot or horseback There are five varieties of oak, white-oak, black-oak, red-oak, Spanish-oak, and swamp-oak The red-oak has very narrow, small leaves and bears little colored acorns, such I have seen nowhere else Besides these, hickory trees of three sorts, ash, white and red beech, sassafras, in some places very thick, poplar and chestnut are the kinds generally found on high lying land In the bottoms there are walnut, linden, maple, water-beech, that grow near to the water and often attain great height and girth, hawthorne and crabapple "

This description clearly distinguishes between associations of the higher lying lands and those of "the bottoms," that is, the upland forest and the swamp forest

In the passages following this description, either immediately or in later pages of his book, Zeisberger supplements his catalogue of the primary species of both forest types by a list of secondary species The overall result is a rather complete picture of the region's plant ecology That is all the more significant since the region's deforestation, within the last one hundred years, has made it impossible to include Tuscarawas County in the ecological survey currently carried on in the counties farther down the Tuscarawas where the original forest had been less interfered with Zeisberger's species, as well as the notes written by the editors of *ZH* (5), have been carefully checked in the light of present-day ecology and taxonomy, necessary corrections were made, and the facts restated in the appropriate terminology of the respective fields (6)

(a) THE UPLAND FOREST

(1) *The Flora of the Upland Forest Area*

The upland forest such as described by Zeisberger was clearly dominated by an oak-chestnut-tulip association, with occasional stands of beech-maple, and oak-chestnut, in between, along the rivers and creeks, hemlock seems to have been frequent, though probably not forming forest areas This entire forest picture is not different from that of the lower Tuscarawas region, with its well established plant ecology

Partly from field experience, and partly from plant-ecological surveys, the following species may be safely claimed for the Tuscarawas valley, in the 1770's, and for the Schönbrunn area, in particular

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature* (acc to *DFI*)
White-oak	*Quercus alba* L	
Black-oak	*Quercus velutina* Lam	
Red-oak	*Quercus rubra* L	*Qu coccinea* Muench, Scarlet Oak
Chestnut	*Castanea dentata* Marsh	

Zeisberger s Name	*ZH Notes*	*Corrected Nomenclature* (acc to *DFI*)
Poplar	*Liriodendron tulipifera* L	
Sugar Tree (Lenape *Achsünnamünschi*, "Stone Tree ')	*Acer Saccharum* Marsh, Sugar Maple	
Hickory (3 sorts)	Carya species	*Carya cordiformis* (Wang) Koch, *C ovata* (Mill) Koch, *C tomentosa* (Lam) Nutt
Ash	**Fraxinus americana* L	
White and Red Beech	Only one species **Fagus grandifolia* Ehrh	*Rapid growth results in much sap wood which is white, slow growth results in much heart wood which is reddish, ACM*
Sassafras	*Sassafras variifolium* (Salisb)	*Sassafras albidium* (Nutt) Nees
Walnut	*Juglans cinerea* L **Juglans nigra* L	
Poison Vine	**Rhus toxicodendron* L Poison Ivy	*Rhus radicans* L
Hazel Nut	*Corylus americana* Walt	
Wild Cherry	*Prunus serotina* Ehrh (the common wild cherry) *Prunus pennsylvanica* L (and probably *Prunus cuneata* Raf)	The Wild Black Cherry The Wild Red Cherry (*Prunus virginiana* L) *probably not in this region – ACM*
Plums	*Prunus americana* Marsh	
Wild Grapes	*Vitis aestivalis* Michx *Vitis vulpina* L	
Mulberry	*Morus rubra* L	
Wild Gooseberry	*Ribes cynosbati* L	*Grossularia cynosbati* (L) Mill
Wild Current (black)	*Ribes floridum* L Her	*Ribes americanum* Mill
Cranberry (Lenape *Pakilun* [*ZH Rakilun ACM*])	*Viburnum opulus* L (the tree cranberry)	*Viburnum trilobum* Marsh, not really a cranberry
Wild Strawberry	*Fragaria virginiana* Duch	
Elm	**Ulmus americana* L	
Spruce (*error*)	(*Picea mariana* Mill , Black or bog spruce)	(?) *Tsuga canadensis* (L) Carr , Hemlock
Pitch Pine	*Pinus rigida* Mill	
(Len) *Wisoweminschi*, ' the yellow tree	*Cladrastis lutea* Michx	
Red Cedar	**Juniperus virginiana* L	
Wild Citrons or May Apples	**Podophyllum peltatum* L	
Wild potatoes and wild parsnips ' (?)	**Ipomaea pandurata* L	Questionable more likely **Apios americana* Medic , or **Helianthus tuberosus* L the Jerusalem Artichoke

*Also found in the swamp forest community

Zeisberger never loses sight of Man as an essential member of the biotic association of the area, nor does he omit a pertinent remark about certain animals in relation to certain plants, or about either of the two in relation to Man

Nothing could have better demonstrated the nature of the Tuscarawas forests than his simple statement "They are not dense, but generally sufficiently open to allow comfortable passage on foot or horseback " In his introductory characterization of the forests (7), he takes care to keep separate the tree community of the forest "on high lying lands", and that of the swamp forest, "in the bottoms " His remark, that "the forest is mainly oak forest," (8) expressly points to the oaks as the dominant genus of the former community which alone he defines as "forest" (*der Busch*) (9) The tree community "in the bottoms" clearly did not measure up to his Central European notions of *Busch* (*Wald*), although he is careful throughout to assign to it the appropriate species of trees, as well as of the accessory vegetation His occasional descriptions of species are concise and competent, and it is rare that he confuses them His description of what he calls the red-oak ("very narrow, small leaves and bear little colored acorns,") (10) really applies to the scarlet-oak, *Quercus coccinea* Muench, nor is his "spruce tree" (11) really a spruce but a hemlock, *Tsuga canadensis* (L) Carr , the error also appears in the notes (12) Both the primary and secondary vegetation of the forest communities is significant to Zeisberger mainly as a means of support for the human species inhabiting the region No fruit-bearing tree or plant is mentioned without also mentioning the use made of such wild fruit, frequently with some comment on its taste or even on the process of utilizing it to the consumers' best advantage Evidently describing *Carya tomentosa* (Lam) Nutt , he writes about "the hickory nut," as follows (13)

> " the hickory nut, found in great plenty in some years and which the Indians gather in large quantities and use not only as they find them—they have a very sweet taste—but also extract from them a milky juice used in different foods and very nourishing Sometimes they extract an oil by first roasting the nut in the shell under hot ashes and pounding them to a fine mash which they boil in water The oil swimming on the surface is skimmed off and preserved for cooking and other purposes "

He discriminates between the white and black walnut, according to the color of their wood, adding that "the latter is very much used by cabinet makers for tables, chests and other things The nuts, the one variety having a very hard shell, are eaten, but are very oily " He mentions that "the one sort" of wild cherries "grows on high thick trees, which are found in large numbers" (*Prunus serotina* Ehrh , the Wild Black Cherry), and that these trees "yield a very fine red wood that is well suited for cabinet work " He also remarks that the wild grapes "growing on high ground or hills" (*Vitis aestivalis* Michx, and *Vitis vulpina* L) are "the best," while "those found in the bottoms are very sour" [*Vitis riparia* Michx] He states (14) that

> "with the white walnut bark, used externally and internally, they [the Indians] effect many cures Laid upon flesh wounds this relieves pain at once, prevents swelling and accelerates healing Applied externally in case of toothache, headache, or pain in the limbs, this brings speedy relief "

The most detailed of Zeisberger's comments on trees in relation to human existence is that on the sugar maple (*Acer saccharum* Marsh) and the boiling of its sap into sugar He writes about it, as follows (15)

> "Sugar trees are usually found in low, rich soil, sometimes, also, on higher land and in more northerly regions [than the Tuscarawas valley, ACM] even on hills, where, however, the soil is very moist The Delawares call this tree the *Achsunnamunschi*, that is, the stone tree, on account of the hardness of the wood The Mingoes give it a name signifying the sugar tree, as do the Europeans From the sap of the tree sugar is boiled This is done by the Indians in the early part of the year, beginning in February and continuing to the end of March or beginning of April, according as spring is early or late In this region [the Tuscarawas valley, *ACM*] it is possible to boil sugar even in fall after there has been frost and in winter, if the season is mild For as soon as the trees thaw a little the sap begins to run and then the trees are tapped As, however, at that time of the year the weather is very uncertain and it is possible that there should be a cold wave at any time, it is hardly worth the effort to make the necessary arrangements and is hardly ever done, unless some one be driven of necessity to provide sugar for the household. This,

we ourselves [the mission community, *ACM*] have been obliged to do and the sisters of our congregation have already boiled a quantity of sugar for congregational love-feasts, shortly before Christmas "

(2) *The Fauna of the Upland Forest Area*

Zeisberger's discussion of the animals, in the Tuscarawas region, with Schönbrunn as its center, presents a rather clear survey of both the dominant and accessory species such as typical of the upland forest Even as in his presentation of the area's forest flora, so he was guided, in the order in which he presents the fauna, by considerations of their usefulness rather than of systematic taxonomy

From Zeisberger's notes (16), we can put down the following species of mammals, birds, reptiles, and insects as zoologically complementing the plant community of the forest areas in "the high-lying places" at and about Schönbrunn

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Mammals		
Deer	*Odocoileus virginianus* Boddaert	
Bear	*_Ursus americanus_ Pallas	
Elk	*Cervus canadensis* Erxleben	
Panther	*Felis couguar* Kerr, Puma	
Wild Cat	*Lynx rufus* (Fuldenstaedt)	*Lynx rufus* Schreber
Red Fox	*Vulpes fulva* Desmorest	
Black Fox	Variety of *Vulpes fulva*	
Gray Fox	*Urocyon cinereoargenteus* Schreber	
Raccoon	*Procyon lotor* L	
Opossum	*Didelphis virginiana* Kerr	
Pole Cat	*Mephitis mephitis* Schreber	
Grey Squirrel	*Sciurus Carolinensis* Gmelin	
Black Squirrel	Black variety of the former	
Red Squirrel	*Sciurus hudsonicus loquax* Bangs	
Ground Squirrel	*Tamias striatus* Rich	This is the Chipmunk
Flying Squirrel	*Sciuropterus volans* (L)	*Glaucomys volans* (L)
Ground Hog	*Marmota monax* L	
Very large variety of wild cat other than the kind already mentioned (17)	*Lynx canadensis* Kerr	
Hare	*Lepus floridanus mearnsi* Allen	
Wolf		*Canis lupus* L
Mice very common	*Peromyscus leucopus* Raf	
Birds		(*The Bird nomenclature in this column is according to The A O U Check List of North American Birds, 4th edition — ACM*)
Wild Turkey	*Meleagris gallopavo silvestris* Vieill	
Pheasant (*error*)	*Bonasa umbellus* L the Ruffed Grouse (or pheasant)	
Heath Grouse	*Tympanuchus americanus* Reich , the prairie hen	*Tympanuchus cupido americanus* Reich , the Prairie Chicken
The Wild Pigeon	*Ectopistes migratorius* L	Passenger Pigeon
Turtle-Dove	*Zenaidura macroura carolinensis* L	Mourning Dove
Partridge or Quail (*in Engl*)	*Colinus virginianus* L	Quail (Bob-White)
Eagle	*_Haliaetus leucocephalus_ L , The Bald Eagle	Never nested in the region — *ACM*
Forked Eagle (Lenape *Chauwalanne*)	*_Elanoides forficatus_ L , The Swallow tailed Kite	Not known to have nested in the region —*ACM*
The Hawk	*Buteo borealis* Gmelin, The Red tailed Hawk	

*Also found in swamp forest area

Zeisberger's Name	_ZH Notes_	_Corrected Nomenclature_
The Stone Falcon	_Falco peregrinus anatum_ Bonaparte, the Peregrine Falcon, or Duck Hawk	
The Pigeon Hawk	*_Falco columbarius_ L	
Description of Woodpecker	_Melanerpes erythrocephalus_ L	
Redheaded Woodpecker	*_Dryobates pubescens medianus_ Swains, the Downy Woodpecker *_Dryobates villosus_ L, the Hairy Woodpecker "The former is smaller and much more abundant"	
Yellow Woodpecker	_Colaptes auratus luteus_ Bangs the Flicker (or Yellow Hammer [?])	
Green Parrots	_Conurus carolinensis_ L, the Carolina Paroquet	_Conuropsis carolinensis ludovicianus_, Gmelin, the Louisiana Paroquet
Owls	_Bubo virginianus_ Gmelin the Great Horned Owl	
"A small owl"	*_Otus asio_ L ("doubtless the ubiquitous Screech Owl")	
Crows	*_Corvus brachyrhynchus_ Brehm	
The Raven	_Corvus corax principalis_ Ridgw	
The Whippoorwill	_Antrostomus vociferus_ Wilson	
The Mosquito Hawk	_Chordeiles virginianus_ Gmelin	_Chordeiles Minor_ Forster
[_Die Amsel_] Blackbird (_European terminology, ACM_)	_Planesticus migratorius_ L the Common American Robin	_Turdus migratorius_ L
The Blue Bird	_Sialia sialis_ L	
The Mocking Bird	_Mimus polyglottus L_ "Very rare in the locality now"	
Descr "A certain yellow bird with black wings"	_Astragalinus tristis_ L	_Spinus tristis_ L
Descr " another kind orange in color with black spots hangs its nest on branches of trees"	_Icterus galbula_ L the Baltimore Oriole	
Descr "Another bird, light red	_Piranga rubra_ L, the Summer Tanager	
Descr " another red bird with black wings	_Piranga erythromelas_ Vieill, the Scarlet Tanager	
The Cat Bird	*_Dumetella carolinensis_ L	
The _Gut Herr_ [—_Häher_] (Blue Jay _ACM_)	Translation omitted in _ZH_, no note —_ACM_	_Cyanocitta cristata_ (L) Strickland
"The Turkey Posser" (Buzzard)	*_Cathartes aura septentrionalis_ Wied	
Swallows	*Hirundinidae	
Finches	"Several Fringillidae (sparrows) most of the thrushes (Turdidae) and probably some of the warblers (Mniotiltidae)"	
"Tom tits"	_Baeolophus bicolor_ L the Tufted Titmouse and, probably _Parus atricapillus_ L, the Chickadee	

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*Also found in swamp forest area

Zeisberger s Name	*ZH Notes*	*Corrected Nomenclature*
Wrens	*Thryothorus ludovicianus* Lath , the Carolina Wren, "is the most abundant and conspicuous species in this region '	
Honey-Bird	*Archilochus colubris* L , the Ruby throated Humming Bird	
Reptiles		
Rattlesnakes ("not as numerous as in some regions that are stony and mountainous ')	*Crotalus horridus* L	
Copperheads ("their bite is as venomous as that of the rattlesnakes ')	*Ancistrodon contortrix* L	*Agkistrodon mokoson* Daudin
Vipers ("Their bite also is venomous')	*Heterodon platyrhinus* Latr , probably *var nigra* 'The spreading viper or hissing adder, an entirely harmless snake generally thought to be poisonous)	*Heterodon contortrix* Latr
Blacksnake	*Zamenis constrictor* L Black Snake or Blue Racer	*Coluber constrictor* L
Descr " green snakes white bellied and more than a foot in length and harmless"	*Liopeltis vernalis* Dekay the Green or Grass Snake	*Opheodrys vernalis* Harlan
"Lizards rarely found One variety, not above 5 or 6 inches in length is said to be poisonous		Either Pine Tree Lizard *Sceloporus undulatus* L or the Blue Tailed Skink *Eumeces fasciatus* L
"Other varieties, some very small, come into the huts that are reared in the forest and are harmless		The young of the preceding species In this region there is no species with "very small adults
" variety of land tortoise in these parts hard shell, small and very prettily marked	*Cistudo carolina* L , the Box or Wood Turtle	*Terrapene carolina* L
Molluscs		
Snails	*' Helix and related forms	
Arthropoda.		
Ticks		*Family Ixodidae
Mosquitoes		*Genera Culex, Aëdes, Anopheles, Psorophora, *et al*
"great and small gad flies"	*"Tabanus Chrysops etc '	
Bees	Apina	*Apis mellifera* L , the Honey Bee *not native American, but early escaped —ACM*
Wasps	Vespina	*Several families and genera of Hymenoptera
Bed bugs		*Cimex lectularius* L
Fleas		Genus Ctenocephalus Cat Flea, Dog Flea possibly also *Pulex irritans* L the Human Flea

*Also found in swamp forest area

Zeisberger not only records his animal species in the order of their dominance but he also does what he had done in discussing the trees and plants he regards them in relation to Man As the most important forest creature, he lists the Deer His excellent description of the Virginia Red Deer (18) reads as follows

> "In the first place, there are the deer, whose skins are much used in barter and trade by the Indians Their horns are not straight, but bent toward each other and have prongs From May until September they are red, after that they lose the red hair and their hide is covered with long, gray hair, which is their winter coat At about the beginning of the year they shed their horns, new ones grow in spring These are at first and until they attain their full size, covered with a thin skin, which peels off when the horns harden The tail is about a foot long and stands up straight when they run As the under side of the tail is white it is possible to see them running at a great distance The young are born in June or about that time, are red, spotted with white, until the fall when they become gray Deer have young each spring, sometimes two As, however, they are hunted so persistently at the call of trade, their numbers diminish with each year, even though the forests are of vast extent, for the hunters are many A large buckskin is valued at a Spanish dollar, two doeskins are regarded as equal in value to one buckskin "

In another place of his book, Zeisberger makes this remark (19)

> "As an Indian shoots from fifty to a hundred and fifty deer each fall, it can easily be appreciated that game must decrease "

In spite of the deer's satisfactory birth rate, Zeisberger is concerned about the survival of both the hunters and the hunted His and the Moravian mission's economic policy was inspired by the realization that the game resources were being recklessly exploited, and that, for the future, there was only one road left open toward the Indians' racial survival a determined change away from the life of the roaming game-exterminator, to the sedentary existence of the farmer and cattle-raiser What was practiced, in this respect, in the Tuscarawas missions, was a highly successful move in the right direction, as long as it lasted It was not the Moravians' fault that all their honest efforts came to naught, their and their converts' neutrality, intended to be a blessing, was held against them by both contending parties of the Revolutionary War, with the result that the missions were destroyed and abandoned

The Bear ranks next in Zeisberger's survey His description reads, as follows (20)

> "The bear is quite black, has short ears, a thick head and quite a sharp snout It has but a very short tail and great strong claws on his feet It can easily climb the trees and bring down chestnuts and acorns This is done, however, only when these are not ripe and do not, therefore, fall down They generally break off the branches, throw them down and then climb down to consume the nuts Where there is food and mast they are found It is as if they knew that in this or that region it would be good for them to live In the fall, when the Indians hunt deer, they take no notice of the bears, otherwise, they would spoil their fall hunting They do, however, notice their tracks and whither they lead At the end of December the bears, having fattened, seek their winter quarters, which they prepare in the trunks of hollow trees or in caves or the thickest part of the forest, where many old trees lie piled up They leave their winter quarters in early spring, if they have young, of which there are generally two, not until May During this period they are said to eat nothing, but to live on their own fat Their skins are no great object for trade, hence the Indians prefer to use them for their sleeping places, for which the long hair makes them peculiarly useful "

In describing the Elk, Zeisberger remarks correctly that "the English distinguish between the elk and the stag in Europe" (21) the European Elk is what in America is called a moose, while the European Stag (*Cervus elaphus* L) is a close relative of the American Elk (*Cervus canadensis* Erxleben) Again he adds some economic comment "As the skins are very thick and heavy and of no particular value, elk do not tempt the Indians to the chase '

He describes the Buffalo, but merely as a thing of the past He writes

> "At one time these animals appeared in great numbers along the Muskingum but as soon as the country begins to be inhabited by the Indians, they retire and are now only to be found near the mouth of the above named river Along the banks of the Scioto and further south, both Indians and whites say that they may be seen in herds numbering hundreds That is two or three hundred miles from here "

Of the Panther (Puma, Mountain Lion, *Felis couguar* Kerr) Zeisberger gives a particularly lively description, obviously inspired by admiration for this sturdy cat, as well as by the wholesome respect which the Indians had for it as a potential enemy Follows Zeisberger's description (22)

> "The panther has a head and face like a cat, its legs are short and the paws are armed with sharp claws It is a beast of prey of uncommon strength Its tail is long, compared with that of the cat Deer it is able to catch at will If it spies one and is desirous of capturing it, the panther crawls along the ground behind fallen trees or through the thicket until it is sure of capturing the deer in one leap Then it springs upon its prey, seizes it with its claws and does not release its hold until the victim is dead If it misses its aim at the first spring, it never attempts a second When the deer has been killed, the panther devours but a small part leaving the rest When again pressed by hunger it seeks a new game At a distance of ten yards from a tree, the panther can leap ten yards up the tree and leap the same distance from the tree It is not known that a panther has ever done the Indians injury without provocation Should an Indian get near the place where the young are kept, then he is in great danger and if he does not know what to do under such circumstances, is almost sure to lose his life He must never turn his back upon the panther, thinking that he can escape He must not take his eyes off the animal, and if he has not the courage to shoot, gently walk backward, until he is a good distance away If he shoots and misses, then he is in imminent danger and must keep his eyes fixed on the panther It has happened that in this way Indians have saved their lives It has occurred that a bear has fought so long with a panther, near to where the latter had its young, that both fell dead The skin of the panther is gray in color, mixed with reddish hair "

In discussing the Raccoon, Zeisberger remarks (23) "The flesh is wholesome and tastes like bears' meat and its skin is useful to hatters "

He gives a clear account of the Opossum's marsupial nature, as well as of its habit of "playing possum," stating, in conclusion, that "the flesh of the creature tastes like pork and is eaten by the English, rarely by the Indians "

His excellent description, vivid and concise, of the Pole-Cat (under its Pennsylvania Dutch appellation, *Piss-Katse*), contains these passages (24)

> "If one's person or clothes have been infected by the moisture, it is necessary to bathe and change before returning into company Even dogs, when they kill the animal, find the stench unbearable Yet the flesh of the creature is eaten by the Indians It is said to be very good and not to have offensive odor "

Evidently he successfully combatted the temptation to ever taste it himself

About the Wolf, Zeisberger records the following pertinent observations (25)

> "Wolves are very numerous, most are gray, some are almost black As

> their skins serve no useful purpose they are not much valued, the Indians do not pursue them, unless, they catch them tearing skins or devouring meat they have carefully laid away Sometimes the wolves break into their hunting huts and do much damage They rarely attack men, never when there are deer to pursue The latter they attack in summer or winter, never stopping pursuit until a victim has been captured Occasionally, the deer save themselves in creeks and rivers, swimming a great distance down stream, so that it is impossible for the wolves to trace them When a wolf has caught a deer and killed it, it will not at once consume the flesh, but go to the highest hill nearby and call its comrades, by howling When these have assembled they devour the deer together "

With the rodents Zeisberger deals briefly, not omitting, however, their significance for the human community Thus, he remarks, about the squirrels, that "their flesh is tender, and eaten by the Indians in case of sickness or when they are very hungry for meat "

Of the "ground squirrel" (Chipmunk, *Tamias striatus lysteri*, Rich) Zeisberger states that it does "great damage in the fields of the Indians, not only digging out the corn when it has been planted, but also pumpkin and melon seeds "

"The Groundhog," he writes, "lives on grass and is very fond of melons and pumpkins The flesh is toothsome and eaten by the Indians " (26)

Zeisberger devoted much attention to the bird population of the forests The Wild Turkey is competently and concisely described, as follows (27)

> "Wild Turkeys may be seen in the fall in flocks numbering hundreds In the summer they disperse in the woods, this being the time for hatching the young In winter their plumage is of a shining black, with white spots on the wings, in summer it changes to light brown When the time comes for laying the eggs, the Indians seek them, as they are very fond of them "

Repeatedly he uses the name of a European bird for an American one resembling closely or distantly the former Thus, in speaking of pheasants, he really refers to the Ruffed Grouse (*Bonasa umbellus* L) which, moreover, had long received, in this country, the popular name of "pheasant," when Zeisberger first met with the species He states that

> "Pheasants are not valued by the Indians, though their flesh is palatable They fall victims, however, to birds of prey Were it not for the birds of prey the woods would swarm with them, for the hen lays above twenty eggs at one time "

What he calls the "Heath-Grouse" is really the Prairie Chicken (*Tympanuchus cupido americanus* Reich), which, as he correctly states (28), is "larger than the pheasants" (Ruffed Grouse) He adds the information that "they are not valued by the Indians any more than the pheasants "

Zeisberger's "Turtle-Doves," which "are smaller than the [passenger] pigeons [previously described] and are always found in pairs," really are Mourning Doves (*Zenaidura macroura carolinensis* L), and his *Patrisel* are "Partridges or Quail" (*Colinus virginianus* L the Bob-White), as he adds in English He describes them as follows (29)

> "Partridges are small, neatly formed chicken fowl In the fall and winter they fly in broods In the settlements they like to remain near the plantations, as they find the food they like in the fields The flesh is tender and of a fine flavor They are favorites with all people, being innocent and harmless birds "

He correctly points out the significant ecological fact that "in the settlements they like to remain near the plantations, as they find the food they like in the fields " A note to Zeisberger's book (30) quotes J M Wheaton (31) as stating that

> " it [the Bob-White] was probably absent or at least confined to but a few localities in the State at the time of the first settlement and has steadily increased in numbers as the forest has been cleared away "

Similar observations have been made with regard to the spreading, in the Old Northwest, of the Cardinal (*Cardinalis cardinalis* L) and the American Robin (*Turdus migratorius* L) both of which were drawn, by the cultivation of fields, into formerly forested areas and, in particular, into the neighborhood of human habitations where they could find with ease the livelihood that best suited their needs, see also below, p 57

Zeisberger gives a good picture of the multitudinous appearance of the Passenger Pigeon (*Ectopistes migratorius* L), once an essential member of the forest community, but now extinct His description reads, as follows (32)

> "The wild pigeon is of an ash-gray color, the male being distinguished by a red breast In some years in fall, or even in spring, they flock together in such numbers that the air is darkened by their flight Three years ago they appeared in such great numbers that the ground under their roosting-place was covered with their dung above a foot high, during one night The Indians went out, killed them with sticks and came home loaded At such a time the noise the pigeons make is such that it is difficult for people near them to hear or understand each other They do not always gather in such numbers in one place, often scattering over the great forests "

Zeisberger then proceeds to list the birds of prey, starting with two species, the Bald Eagle and the Swallow-tailed Kite, that probably never nested in the Tuscarawas forest area The other species mentioned are resident members of the upland forest community

The minor species that complete the picture of the bird population of that forest have, in part, been described, rather than named, by Zeisberger From these descriptions it has been easy to identify the species Zeisberger had before his eyes In only one case, it is doubtful what bird he had in mind, he writes "Another kind of birds, light-red in color, is particularly beautiful " This may be the Summer Tanager (*Piranga rubra* L), but it is also possible that Zeisberger was describing the Cardinal (Redbird, *Cardinalis cardinalis* L), although some ornithologists doubt whether this bird, today inseparable from the Ohio scene, had, in the 1770's, started on his invasion of the land west of the Ohio River

It is of interest to the linguist, rather than the ornithologist, that Zeisberger, in clearly describing the American Robin (*Turdus migratorius* L), calls it "The Black-Bird" (33) A note in Zeisberger's book (34), pertaining to this seeming incongruity, reads as follows

> "A European bird, *Merula merula*, a near relative of our robin, is black, has habits like our robin, and is commonly known as the blackbird Before the white settlers came, the robin doubtless lived in open places in the forest, so that in the author's experience it was met with only in breaks in the forest, usually remote from the Indian villages With the opening up of clearings the robin made acquaintances with the white man and came to live in open groves and orchards This the robin did in common with many of our other native birds which formerly lived only in the open places in the forest With the coming of the white settlers these birds found congenial homes in the clearings and orchards where they were also less subject to the attacks of predaceous birds and mammals "

It is hardly doubtful that the European Blackbird, centuries ago, had undergone an analogous ecological transition from the forest clearings to the gardens and orchards of the human settlements This is all the more plausible since the European Blackbird and the American Robin, in their appearance (apart from the coloration), habits, and habitats, are so much alike that they are probably to be regarded as local varieties of each other

Next, Zeisberger gives much attention to the snakes of the area "Here along the Muskingum," he writes (35), "rattlesnakes are not as numerous as in some regions that are stony or mountainous" Nevertheless, they seem to have been frequent enough to be assigned first place among the reptiles of the Tuscarawas forest area His description is nothing short of classical (as are so many of his descriptions), in that it combines excellent observation with a marvellous conciseness in the presenting of facts It merits quotation in full

> "The most dangerous snakes are the rattlesnakes They are yellow in color, marked with black spots The largest are about four feet long, sometimes more, and about as thick as an arm The rattles are at the end of their tails, and often betray the snakes when they are not seen These rattles appear to be a thin, transparent horny substance, arranged in links From the number of links it is possible to tell the age of the serpent, one being added every year It is a rare thing to find one with twenty rattles When the rattling sound is heard, it is a sign that the serpent is angry, the trembling of the tail causing the rattling Even when they glide along the rattles make a slight sound which can, however, be detected only by those well acquainted with the ways of the snake They do not rattle unless something approaches them Head and mouth are rather broad in proportion to the size On either side of the mouth they have two very sharp teeth, which lie concealed in a skin sack until they want to bite, when they are able to move these forward with great swiftness Hence, it is that when anyone has been bitten four little openings close together may be seen in the skin If a rattlesnake has been killed, which often happens, as they do not seek to escape nor go out of the way for any one, and one draws forward the teeth with a little stick, a clear liquid spurts out of the bag lying at the root of the teeth This is the poisonous juice Undoubtedly, the teeth in themselves are also poisonous Indians who have been bitten, even if they happen to be quite alone in the forest, know what to do They seek certain herbs and roots that may be found anywhere and cure themselves of the bite, so that one rarely hears of death occasioned by the bite of this serpent Horses or cattle bitten in the woods, where it is not possible to render immediate assistance, die in a short time With proper management these animals may recover in twenty-four hours With human beings a cure is not effected so quickly, and a curious thing is that the part where a human being has been bitten, becomes spotted like a rattlesnake The fat of the rattlesnake is used by apothecaries"

Zeisberger is not correct in stating that "the teeth in themselves are also poisonous," or that "the part where a human being has been bitten, becomes spotted like a rattlesnake" His statement about the other snakes of the forest region are, on the whole, authentic, although they contain a few minor errors, for instance, when he writes that the Viper's "bite is venomous" The snake which he describes (36) is obviously *Heterodon contortrix* Latr, "the spreading viper or hissing adder, an entirely harmless snake generally thought to be poisonous" (37) In describing the "Hornsnakes" (38) as separate in kind from the Copperheads which they are, he does no worse than does the professional herpetologist when, on the grounds of a minor peculiarity, he establishes a new species, or a variety of one recognized

Zeisberger concludes his description of nine different snakes with a few miscellaneous remarks about the life and feeding habits of some of them Again he emphasizes the fact that "none are so numerously represented as the rattlesnakes," and then he states (39) that

"all of them, be they venomous or non-venomous, swallow whole whatever

> they eat Frogs, toads birds, *Ground Squirrel* [English term used in German ms, Z refers to the Chipmunk (*cf* above, p 55), *ACM*], squirrels, hares [rabbits ?], they devour, not in one gulp, however, but gradually They start by the hindlegs and gradually draw [the creature] in, often this takes a long time All snakes, in spring when they leave their holes in the ground, shed their old skin Hence, one often finds an entire skin, in the exact shape of the snake, with the head and everything, only very thin Black-Snakes, after having shed their old skin, look a very glossy black When a rattlesnake bites itself—it does not happen except when it is incited to doing so out of anger and fury, incapable of avenging itself on anyone else—it speedily swells up, almost to the bursting point, so that it can no longer move away, and dies within a few hours "

So far, I have been unable to ascertain whether this latter statement is, or is not, correct, there is no reason why the venom should not effect its own carrier once that it has entered the blood stream with which, under normal condition, it is in no contact whatsoever Nor have I been able to find out how much truth there is to the well-known story of the paralyzing fascination (also attributed to other, oldworld, snakes, I think, as early as Herodotus) of the rattler's eye, Zeisberger makes the following statement about it (40)

> "This snake is said to possess another peculiar property, as witnessed both by Indians and whites *viz* that of gazing with fixed eyes upon bird or squirrel and by a kind of fascination, stupefying them, so that they not only cannot escape, hard as they may try, but also that such a creature is forced to descend from its tree and come to the snake which then seizes it and gradually swallows it up "

This "descending from the tree and coming to the snake" is sure to be an overstatement, while there may quite well be something to the hynpotizing quality in the gaze of a snake approaching its prey on level ground

In conclusion of his description of a ' land tortoise" with "a hard shell small and very prettily marked," he writes Flesh is also eaten' (41) The species is *Terrapene carolina* L , the Box or Wood Turtle Excavations back of Zeisberger's log house, at Schonbrunn, are supposed to have yielded a great number of shells of this turtle although I am unable to substantiate this rumor, if it is true there can be little doubt that Zeisberger himself had not been averse to cracking a turtle, once in a while, for his dinner

"Lizzards are but rarely found here," writes Zeisberger (42) The scarcity, in the North American forest, of lizzards strikes the observer from Central Europe no less than the abundance, in both species and specimens, of turtles, in the freshwater bodies of America Zeisberger's "one variety, not above five or six inches in length," which "is said to be poisonous," is either the non-poisonous Pine Tree Lizard (*Sceloporus undulatus* L), or, less probably, the Blue-Tailed Skink (*Eumeces fasciatus* L), less probably, because Zeisberger careful observer that he was, would hardly have failed to notice, and to mention in a descriptive passage ,the beautiful blue of that lizard's tail Here is what he tells about his lizard (43)

> "Indians make much ado when they see them and try to frighten them away They dwell in hollow trees, where they also keep their young '

Then he tells about "other varieties, some very small " which "come into the huts that are reared in the forests and are very harmless" (44) Since there is no species known in the region, with adults "very small," these "other varieties must have been young specimens of the species listed above

He mentions snails (evidently some species of genus Helix), adding that "from one variety spring, it is believed, the many large gad-flies which in the summer, in the months of July and August, worry the cattle to such an extent that during the day they cannot graze in the forest " Then he speaks of the saliva-like fluid these snails deposit, "presumably containing the eggs of the animal, which are hatched out by the sun," and concludes "from this [fluid], it is supposed that the pestiferous gad-flies are hatched out " This is one of the very few erroneous beliefs concerning natural phenomena, found in Zeisberger's book, which, however, he shared even with the professional scientists of his age (45)

"Wasps are found in large numbers," Zeisberger writes (46) without going into further detail or description, and "of bees," he states, "nothing was known when we came here in '72, now they are to be found in large numbers in hollow trees in the woods" (49) These bees, I have been assured by an entomologist, were not of the genus, Apina (48), but were European honey-bees (*Apis mellifera* L) early introduced into the American colonies, from whence escaped swarms steadily spread the species westward Zeisberger's remark about the absence of bees in the Schönbrunn region, prior to the coming of the Moravians, in 1772, is ecologically significant in that it indicates a lacking of the bees' principal food pollen and nectar, which had been practically absent in the densely forested location, but later became abundant in the same area, after it had been cleared and, in a large measure, turned into orchards, whose bloom would naturally attract bees even from distant places and cause them to settle in hollow trees of the neighboring forest The Indians, in turn, had long learned to use the honey in their diet, its possession being only disputed by the numerous bears which, besides, were also attracted by the fruit of the orchards, as is evident from Major McMahon's report, to Heckewaelder (49), about a visit, in 1792, to the site of the abandoned mission of Gnadenhütten

(b) THE SWAMP FOREST

(1) *The Flora of the Swamp Forest Area*

In his general description of the Tuscarawas forest, such as quoted above (p 46), Zeisberger characterizes the swamp forest, as follows

> "In the bottoms there are walnut, linden, maple, water-beech, that grow near to the water and often attain great height and girth, hawthorne and crabapple" (50)

It has been previously mentioned (above, p 46) that Zeisberger, when speaking of forests did not include the tree growth "in the bottoms," which evidently did not correspond with his Central European concept of "forest" ("*Busch*"), yet he is careful to point out the dominant species of the swamp habitat, as well as to pay attention to the accessory members of the river bottom community

The same method as applied above (p 46) to the establishment of the upland community of plant species has been followed in regard to the swamp-land community, hence, the following species may be claimed for the Tuscarawas bottoms, and for those near Schönbrunn, in particular

Zeisberger s Name	*ZH Notes*	*Corrected Nomenclature* (acc to *DFI*)
Black Walnut	**Juglans nigra* L	
Linden	*Tilia americana* L	
Maple	"*Acer saccharinum* L the silver maple is most abundant near the water, though **Acer saccharum* Marsh the sugar maple, and *var Nigrum* (Mx) also occur in the bottom lands (?)	
Water-Beech	"Most probably *Platanus occidentalis* L , the sycamore ' (See *ZH*, note 119)	
Hawthorne	Crataegus species	

*Also found in the upland forest community

Zeisberger s Name	_ZH Notes_	_Corrected Nomenclature_ (acc to _DFI_)
Crabapple	_Pyrus coronaria_ L (and _Pyrus angustifolia_ Ait)	_Malus coronaria_ (L) Mill
Hoop-Ash	_Fraxinus nigra_ Marsh the black ash	Hoop-Ash is correct —_ACM_
Honey Locust	*_Gleditsia triacanthos_ L	
Dogwood	_Cornus florida_ L	Flowering Dogwood
Red Cedars	*_Juniperus virginiana_ L	
Spruce Tree (_error_)	(_Picea mariana_ (Mill) Black or log spruce)	*_Tsuga canadensis_ (L) Carr the Hemlock
Elm Tree	*_Ulmus americana_ L	
Stone Birch	_Betula nigra_ L the river birch	
Aspen	_Populus tremuloides_ Michx the American aspen	
Vines	*_Vitis vulpina_ L	
Oak trees (_not expressly mentioned by Zeisberger as occurring in the bottoms_)	_Here is some confusion of species in the notes, (see ZH notes 110a–110e)_	_The swamp forest species found in the area are_
Swamp-Oak		_Quercus bicolor_ the Swamp White Oak
Spanish Oak (?)	_Quercus palustris_ Muench	_Quercus palustris_ Muench the Pin Oak
Beech	*_Fagus grandifolia_ L (see above p 47)	
Hickory (_not expressly mentioned by Zeisberger as occurring in the bottoms_)		_Carya laciniosa_ (Michx f) Loud *_Carya cordiformis_ (Wang) Koch
(_Descr_) a larger variety of chestnuts not fit to eat	_Aesculus glabra_ Willd the Ohio Buckeye	
Wild Laurel "Laurel also called the wild box	_Benzoin aestivale_ L the common spice bush apparently	
Poison Vine	*_Rhus toxicodendron_ L ' Poison Ivy	_Rhus radicans_ L
" some poisonous trees	"_Rhus vernix_ L the poison sumac our most poisonous plant	
Cranberries (Lenape _Pakilun_ [_ZH Rakilun—ACM_])	_Vaccinium macrocarpon_ Ait the Common Cranberry	
Wild Citrons or May Apples	*_Podophyllum peltatum_ L	
"Wild potatoes and wild parsnips (?)	*_Ipomaea pandurata_ L	More probably *_Apios americana_ Medic or *_Helianthus tuberosa_ L —_ACM_

*Also found in the upland forest community

The trees and plants of the swamp forest, such as listed above on the basis of Zeisberger's pages, clearly hold a place of inferior economic importance for the natives of the area, as compared with the plant community of the forest on the "high-lying land" It seems, however, that, as a source of medicinal substances, they rated above the economically dominant forest area of the region

Although Zeisberger expressly disclaims to be an authority on medicinal herbs and roots (51), he occasionally drops valuable hints at the pharmaceutical use of some plants Thus he states, with regard to Flowering Dogwood (*Cornus florida* L), that "the rind of the root is used in the apothecary shops in place of Jesuit-Bark," that is, Cinchora bark, from which quinine is extracted "The bark of stone birch trees" (***Betula nigra*** L , the River Birch), "as of many others," writes Zeisberger (52), ' the Indians pound fine, mix with water and use as a medicine " About the Spicebush, ***Benzoin aestivale*** (L) Nees, which he calls Wild Laurel ["*wilder Lorbeer*"], (and, later, "Laurel, also called the wild box"), Zeisberger remarks that "its wood is used by the Indians for medicine and called by the English, spicewood," "it has a strong odor and taste" (53) Later in the book (54), he informs the reader that "the wood is fine and hard," and that "the Indians make spoons of it The main stem does not become thicker than a leg The leaves are green summer and winter "

About the very plentiful crabapples of the region, he remarks that "the Indians, being very fond of sharp and sour fruit, eat them in abundance " This same bend of taste explains the Indians' liking for "Wild Citrons or May Apples " "The Indians enjoy eating the fruit," remarks Zeisberger (55), "which has a sour but pleasant taste " He adds the interesting information that "the roots are a powerful poison which, who eats, dies in a few hours' time unless promptly given an emetic '

(2) *The Fauna of the Swamp Forest Area*
(*including the Lagoon and its Littoral Fringes*)

Here following, Zeisberger's notes on the animal life of the swamp forest in the Tuscarawas bottoms are presented in conformity with the list containing the animal species of the upland forest (see above, pp 49) Included are amphibious species, that is, such as need a body of water for either their subsistence or the completion of their life cycle, or both ' The Lagoon' is a swampy meander loop of the Tuscarawas, at the foot of the Schönbrunn plateau

Zeisberger s Name	*ZH Notes*	*Corrected Nomenclature*
Mammals		
Bear	**Ursus americanus* Pallas	
Otter	*Lutra canadensis* Schreber	
Beaver	*Castor canadensis* Kuhl	
Muskrat	*Fiber zibethicus* L	*Ondatra zibethica* L
Birds		
Wild Geese	*Branta canadensis* L the Common Wild Goose	(*The bird nomenclature in this column is according to the A O U Check List of North American Birds, 4th edition — ACM*)
Wild Ducks	Several species esp the Wood Duck, *Aix sponsa* L	
Sheldrakes	*Mergus americanus* Cassin the Common Merganser and *Lophodytes cucullatus* I the Hooded Merganser	
Crane	' evidently *Grus mexicana* (Müll) the sandhill crane a bird now rare in Ohio (*ZH* p 165, n 182)	*Grus canadensis tabida* (Peters) acc to Dr Edward Thomas
Wild Swans	*Olor columbianus* Ord the Whistling Swan, and *Olor buccinator* Rich , the Trumpeter Swan Both fit Zeisberger s description (*ZH*, p 65) The former is now [1910] less rare	*Cygnus columbianus* Ord *Cygnus buccinator* Rich

*Also found in the upland forest area

Zeisberger s Name	*ZH Notes*	*Corrected Nomenclature*
Eagle	**Haliaetus leucocephalus* L the Bald Eagle	Acc to Dr Edward Thomas it never nested in this region
Loon	*Gavia immer* Brunn	
Descr ' a bird, fishing, that makes nest in the ground along steep banks of creeks or rivers where it makes a hole just large enough to slip in	*Ceryle alcyon* L the King fisher	
Heron	*Ardea herodias* L the Great Blue Heron	
Hoopoe ('*der Wiedehopf*)	*Butorides virescens* L the Green Heron	Identification uncertain possibly the Green Heron more probably *Ceryle alcyon* L the Kingfisher —*A C M*
Starlings	Any one of the following Icteridae (Blackbirds) *Quiscalus quiscula aeneus* Ridgw the Bronzed Grackle *Molothrus ater* Bodd the Cow Bird and *Agelaius phoeniceus* L the Red Winged Blackbird	
Snipe	*Macrorhamphus griseus* (probably)	Acc to Dr Edward Thomas probably Wilson s Snipe *Capella delicata* (Ord)
The gull is frequently seen near rivers and lakes	Larus spec	
"two kinds of plover (*follows description*)	*Aegialitis vocifera* larger variety	*Oxyechus vociferus* (L), Kill deer

For other birds occasionally found in the Swamp Forest area see above (p 49) in list of birds of Upland Forest species marked with (*)

Reptiles		
Descr " snake found here I have met with in no other region The belly is quite red found in the water and on land etc	Apparently *Natrix fasciata* Shaw the red bellied water snake harmless though thought poisonous (*Note 225*)	*Natrix erythrogaster* Shaw Dr Edward Thomas thinks that the occurrence of this snake in the Tuscarawas valley is to be doubted
Descr 'Watersnakes spend much time in the water live on fish and are not poisonous	*Natrix fasciata sipedon* L	*Natrix sipedon* L
Descr "A kind of striped brightly marked snakes which are small and harmless	*Eutaenia sirtalis* L the Garter-Snake	*Thamnophis sirtalis* L
' The River Tortoise a species different from that found in Pennsylvania which has a hard shell soft shell head small and pointed like that of a sea tortoise, etc	*Trionyx spinifer* LeSueur the common Soft Shell Turtle	*Amyda spinifera* LeSueur

*Also found in the upland forest area

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Amphibians		
Descr " another variety of fish, or whatever one may call it resembling a small catfish but having four short legs It has a wide mouth and is about a foot and a half in length The fins are short	(*Note 248*) "This is a very peculiar reference to the water dogs, *Necturus maculatus* Rafinesque, the water dog with external gills and *Cryptobranchus alleganiensis* (Daudin), the hell bender or water dog without external gills	*Necturus maculosus* Rafinesque Only *Cryptobranchus alleganiensis* leaves the water, *Necturus maculosus* belongs to the aquatic fauna —*A CM*
' frogs of a brownish color do not croak but have a note like a short whistle	"*Hyla pickeringii* Storer a Tree Frog living near the water in spring and early summer (*note 249*)	*Hyla crucifera* Wied
'Green Frogs are but rarely met with and only in rivers and brooks	*Rana clamata* Daudin	*Rana clamitans* Latreille
Bull Frogs inhabit rivers and large brooks	*Rana catesbiana* Shaw	
Molluscs		
Snails	*"Helix and related forms	
Arthropoda		
Mosquitoes		*Genera Culex, Aëdes Anopheles Psorophora *et al*
Ticks		*Family Ixodidae
great and small gadflies	* Tabanus *Chrysops etc	
Wasps	Vespina	*Several families and genera of Hymenoptera

*Also found in the upland forest area

As in his treatment of previous associations, of both plants and animals, Zeisberger discusses the fauna of the swamp forest area in the light of its significance for the species *Homo sapiens*, the truly dominant one of all ecological provinces, because it dominates consciously and with a purpose Although nowhere in his pages he says so in so many words, his anthropocentric brand of ecology was sustained by a strong awareness that nature existed solely for the benefit of man, an awareness supported not only by traditional theology but also by the secular rationalism of the era, commonly known as 'enlightenment' Moreover, considerations of the greater or lesser usefulness of any given object of nature would all the more enter into the mind of a writer who was forced to subsist, remote from the cultural sources of his homeland, in the wilderness of a foreign continent, surrounded by, and to a high degree depending on, natives who themselves were at the mercy of their habitat's natural resources Considering this one cannot enough admire Zeisberger's objectivity as an observing and recording naturalist

The Bear, as a member of the swamp forest community, is brought in only at the very end of Zeisberger's volume, in fact, in its concluding paragraph Here, in describing a plant which he calls Laurel (currently named Spice-Wood, ***Benzoin aestivale*** (L) Nees), he writes, as follows (56)

> "Laurel, also called the wild box, grows along river banks, or in the swamps in cool places or on the north side of mountains It grows so thickly that it is impossible to get through In swamps of laurel, bears like to make their winter quarters "

It should be noted that in his principal paragraphs on the bear and its life habits (57), the laurel swamps are not mentioned among the bear's preferences for winter quarters

Of the Beaver and its amphibious life habits, he gives the following, excellent description (58)

> "The beaver was formerly found in great numbers in this region, but since the Indians have learned from the whites to catch them in stell-traps, they are more rarely found A necessary thing in connection with the beaver-catch is a certain oil or spirit which the Indians prepare of various kinds of bark of trees and other aromatic things, which they place in the traps to decoy the beavers into them The skins are always of considerable value They are very industrious animals and, for their size, of uncommon strength Beaver dams of such dimensions are found in creeks (59), that it might be imagined that they had been built by human hands Such dams they build when there are many together, for they work harmoniously, at night, in order to dam up the water and often put a considerable piece of land under water in course of their operations In the middle of the dam they build their dwelling places that are raised above the water, wood and earth being the materials used As their dens are in the middle of the lakes they cannot be easily reached In the front part of the mouth they have four quite broad and very sharp teeth, two above and two below With these they are able to gnaw through trees that are nearly a foot in diameter When the tree is down they divide it into pieces of such size that they are able to manage them These pieces carried into the water, they join together in such a fashion that the water cannot tear them apart I have myself seen in quite a large creek a beaver dam, in which the beavers were still undisturbed at home, so that I could observe their habits and work The dam extending straight across the creek, reached three feet above the water, so that it was possible to cross the creek dry shod, and put several acres of land under water In another place, where the water had threatened another course, they had been obliged to build another dam, made of earth and branches of trees Had this dam not been so far from human habitation, one might have thought it had been constructed by men The animals are of a dark brown color, have short legs and broad feet, adapted to swimming and armed with short claws The tail is broad and flat At the end it is broadest, smooth, without any hair, and looks as though covered with fish scales The tail furnishes the best flesh and is much liked by the Indians It has an appearance different from the rest of the animal's flesh, being more like fish meat As the skins always bring a good price the Indians hunt these animals constantly "

This description is accompanied by an editorial note (60) stating that

> "the steel trap was another white man's invention which, placed in the hands of the Indians, proved most destructive to some of the animals which formerly held their own against the less effective methods of the Indians The price paid for the pelts by the whites, was of course an additional factor in the destruction of many of the native animals "

Here was another case of exstinctive hunting mainly due to "improved" equipment furnished by the white intruders who, moreover, put a premium on the reckless exploitations of the hunting grounds, hastening thereby the economic disruption of the natives, which eventually led to their doom

About the Muskrat Zeisberger (61) makes the pertinent statement that, being "able to live in or out of the water," it

> "is in many respects most like the beaver Its tail is not broad as that of the beaver, but oval-shaped Their dwellings are in the water, but so arranged that they can, according to inclination, be in the water or in a dry place A great quantity of odorous matter is found in the body of this animal The odor is unpleasant when too strong, but a little of it is agreeable "

The greater or lesser food value, for the Indians, is stressed by Zeisberger in his description of quite a number of the birds found on or near the water Thus he records (62) that the male of the "Tree-Duck" (*Aix sponsa* L , the Wood Duck) "is the most beautiful of the water-fowls and very good to eat," evidently not exclusively to the Indian taste About the Sheldrake (*Mergus americanus* Cassin, and *Lophodytes cucullatus* L) he states (63) that "they live on fish, their flesh having the taste of fish Indians rarely use them for food, though the flesh of some is very palatable " According to a note (64), the latter remark seems to apply to *Lophodytes cucullatus* L , "the Hooded Merganser, which is said to be quite palatable, the flesh of the other mergansers being rank and fishy " The flesh of the Crane (most probably *Grus canadensis tabida* [Peters]), according to Zeisberger (65), "is dark, rather tough and seldom eaten by the Indians " They much more relished the flesh of the Wild Swans, for Zeisberger writes (66) that "the Indians declare that their flesh tastes like that of the bear, of which they are particularly fond, and is often so fat that pieces [of fat] may be cut from the flesh " The Loon, Zeisberger states (67), "is not eatable, but the Indians make pouches of its skin, which is taken off whole, large enough to hold pipe, tobacco, flint, steel and knife "

Zeisberger is quite definite (68) about having "found here," that is, in the Schönbrunn area, "one variety of snake" which he had "met with in no other region "

> "The belly is quite red These serpents may be found in the water and on land They get to be from five to six feet in length and their bite is poisonous To cure the bite of this reptile the Indians use a plant that grows in the water These snakes have teeth all around the mouth, above and below, but no fangs "

As far as the description goes, it clearly fits the Red-Bellied Water-Snake (*Natrix erythrogaster* Shaw), and it is evident that he did not intend to describe a venomous snake, that is, one, such as a rattlesnake, with fangs functioning like a hypodermic needle In fact, he states expressly—and obviously from personal investigation—that the teeth, "above and below," are set "all around the mouth " and that there are "no fangs " Nevertheless he declares that "their bite is poisonous " At a first glance there seems to be an incongruity between the two statements But there really is none, for Zeisberger does not say that it is a poisonous snake, but merely that "their bite is poisonous " Some herpetologists claim to possess observations on the toxic effect of watersnakes' saliva on persons bitten by them, while others are emphatic about there being nothing to it they themselves as well as acquaintances of theirs had been bitten many a time by watersnakes without even a trace of a reaction No one who is familiar with the facts of "selective toxicity" will declare either of the two observations incorrect The truth in the matter apparently is that some persons show toxic reactions to the bite of watersnakes (Natrix, and related genera), and to that of *Natrix erythrogaster* Shaw, in particular, while others do not

Zeisberger's reliability as an observing naturalist has been questioned on the grounds of a story he tells about a horse, bitten by a black snake, having died despite all possible efforts to save it Of course, here he doubtless recorded a faulty observation either the horse's death was due to another cause (possibly, the bite of a rattlesnake) while the Black-Snake just happened to be around, or, he related his story from hearsay but not from personal observation Whatever its source may be, errors such as this occur in the records of all observers, be they naturalists or historians, and it would be unfair to discredit on their account a man's entire work, unless there is cogent evidence to an intent to defraud Such an accusation could never be raised, even by malevolent critics, against Zeisberger who, in small matters, may have occasionally erred, though always in the best of faith Whoever objectively and thoroughly studies his notes will increasingly gain the assurance of dealing with a source-book of high importance for historians in various fields

One more reptile which Zeisberger comments upon is the Common Soft-Shelled Turtle (*Amyda spinifera* LeSueur) (69) After a concise description, he writes

> "The Indians shoot them, for they are not easily caught in any other way, as they seldom venture out of the water upon the banks of the river The Indians are very fond of the flesh and of the eggs which the animals lay in the sand on islands "

(II) THE LAGOON AND THE RIVER

Not entering upon a discussion of aquatic plants, Zeisberger (70) at once proceeds to list and describe the fishes of the area Nowhere in his book does his integrity as an observing naturalist stand out more clearly than in the brief introductory paragraph to his ichthyological survey It reads, as follows

> "Of fishes, there are doubtless many more varieties than those I have seen in the Ohio I will, however, confine notice to those I have seen and know "

What here he calls "the Ohio" apparently included, to his mind, those tributaries with which he was primarily concerned the Muskingum and, especially, the Tuscarawas

(a) *Aquatic Flora*

No water plants are discussed in Zeisberger's book from the fact, however, that the Indian women made mats of ' rushes which grow in ponds or stagnant water" (71), and also, of the leaves of Flag, or Cat-Tail (72), it may be inferred that these plants grew in the Tuscarawas area The latter reference, from a Friedenshutten (Wyalusing) Diary is validated, for the Tuscarawas region by an entry (July 3 1773) in a Gnadenhutten Mission Diary which states that "some of the sisters went out to look for *Binsen* [rushes] for mats " The grasses used for the purpose were *Scirpus pungens* L the Bulrush and *Typha latifolia* L, the Cat-Tail (73)

(b) *Aquatic Fauna*

In addition to the Fishes there are to be included a very few species previously listed above, from the Reptile and Amphibian classes of vertebrates which never or rarely leave the water Also to be included are the larva forms of all amphibians previously listed, as well as the larvae of the mosquitoes and gad-flies mentioned above (p 62) Water birds are listed on pages 60–61

Zeisberger s Name	*ZII Notes*	*Corrected Nomenclature*
Reptiles		
The River Tortoise (see above, p 61)	**Trionyx spinifer* LeSueur the Common Soft Shell Turtle	**Amyda spinifera* LeSueur
(*Descr*) "Watersnakes spend much time in the water live on fish and are not poisonous	**Natrix fasciata sipedon* L	**Natrix sipedon sipedon* L
Amphibians		
(*Descr*) ' another variety of fish or what ever one may call it, resembling a small cat fish, but having four short legs ' Etc see above p 62	*Necturus maculatus* Rafinesque The Water Dog with external gills and **Cryptobranchus alleganiensis* (Daudin), the Hell bender, or Water Dog without external gills	*Necturus maculosus* Rafinesque (never leaves the water, **Cryptobranchus* does -*ACM*)
Fishes		
"Pike are of uncommon size and generally known	(*Note #31*) "*Stizostedion vitreum* Mitchill the pike perch or jack salmon etc	*Esox masquinongiohioensis* Mitch

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*Also listed with the Fauna of the Swamp Forest Area including the Lagoon and its littoral fringes See above p 61

Zeisberger s Name	*ZH Notes*	*Corrected Nomenclature*
The Black Fish	'probably *Moxostoma aureolum* (Le Sueur), the Common Red Horse or *Catostomus commersonii* (Lacepede) the White Sucker, or *Cycleptus elongatus* (Le Sueur), the Black Horse '	
The Buffalo-Fish	several of genus *Ictiobus*, etc '	Error the description fits the Sheep's Head, *Aplodinotus grunniens* Rafinesque, acc to Mr M Trautman
The Catfish	'Several species in the Muskingum, *Ictalurus punctatus* Raf, the Blue Cat *Ameiurus lacustris* Walbaum the Mississippi Cat *A nebulosus* LeSueur the Bull Head and *Leptops olivaris* Raf the Mud Cat '	*Ictalurus lacustris* Walbaum *Pilodictis olivaris* Rafinesque
The Sturgeon	*Acipenser rubicundus* LeSueur	*Acipenser scaphorhynchus platyrhynchus* Rafinesque acc to Mr M Trautman
(*Descr*) " fish with a narrowly formed mouth, armed with sharp teeth almost like the bill of a duck	*Lepisosteus osseus* L the Gar-Pike	
(*Descr*) " another kind resembles the Cat Fish very much It has no scales broad plain beak like the bill of a goose, almost the length of a hand This it uses to dig in sand and slime in search for food The mouth opens below	*Polydon spathula* Walbaum the Spoon Bill Cat	
' The White Perch is short and broad It has scales and is good to eat	*Aplodinotus grunniens* Rafinesque the White Perch also called Fresh Water Drum grunting or drumming noise	Z s description too vague for identification but *not Aplodinotus grunniens* Raf (see above, p 65)
The Yellow Perch one of the most palatable fishes	*Perca flavescens* Mitchill	*Stizostedion vitreum* Mitch
' Eels are rarely found	*Anguilla chrysypa* Rafinesque	*Anguilla bostoniensis* LeSueur 'possibly one of several species of lamprey" (Dr Edward Thomas, *cf* *ZH* notes 63 and 241)
Molluscs		
(*Descr*) "Two varieties of shell fish are found as well One resembles the clams found along the sea coast the inside of the shell being violet shading to red, the other has a larger shell which is white inside	(*Note 245*) "There are many species of mussels occurring in the region belonging to the genera, Unio, Anodonta Lampsilis etc , the shells of several of these have a colored nacreous layer	
Some specimens of smaller varieties are also found	"Other Unio species (?) '	

As remarked above the fish called "The Buffalo-Fish" by Zeisberger (74) is given a description which precisely fits the Sheep's Head It is an especially fine example of its kind and reads as follows

> "The buffalo-fish is thus called by Indians and Europeans because of its being heard sometimes to bellow in the water Its length is about a foot and a half or even two feet and its breadth five or six inches It has a curved back, prickly fins, a narrow mouth, and a small head in which two white stones are found flat on one side and a little convex on the other These are not ordinary stones but have a stony appearance The fish has no teeth, but at the entrance of its throat there are two strong flat bones, with grooves exactly fitting each other With these it can crack the hardest mussels, which are its chief food, and serve to bait the hook in angling for it The Indians, however, rarely using a hook and line commonly pierce this fish with an iron prong of their own making If any one should venture to put his finger into its mouth, even when to appearance it is half dead, he is in danger of losing one or more of his fingers, for the mussel shells which the fish constantly cracks are very hard "

In his description of the Sturgeon, Zeisberger remarks that it "is the largest of the fish in the Muskingum The largest caught here were from three to three and a half feet in length " In view of this statement, one is surprised to read in the Schönbrunn Diary (75) that ' the brethren went fishing today and caught several large fish, from four to five feet in length," and again, under July 19, 1773, that, in a fine catch of fish, made that day, there were 'some very large, from six to seven feet in length "

Of course, there are several possible explanations for this ' fish story ' Either, the fortunate Indian fishermen exaggerated shamefully to the recording Missionary (possibly Zeisberger himself) who somehow may have failed to inspect the catch with his own eyes, or, fish of that size were actually caught in those days In the notes to Zeisberger's book the following quotation is found (76)

> "Judge Gilbert Devoll took a pike in the Muskingum which weighed nearly one hundred pounds, on the 2nd day of July, 1788 He was a tall man but when the fish was suspended on the pole of the spear from his shoulder, the tail dragged on the ground, so that it was about six feet in length The enormous fish was served up on the 4th of July at a public dinner "

According to the editors of Zeisberger's History (77) "the pike" is not *Esox masquinongi ohioensis* Mitch , but *Stizostedion vitreum* Mitch (currently called the White Perch), which they call 'the pike perch or jack salmon " Thus it would appear that this fish was about the biggest of them all in the Muskingum, but not the Sturgeon, as claimed by Zeisberger It is hard to decide which of these ' fish stories," if any, is absolutely true

REFERENCES

With abbreviations used in these pages

DFI—Deam Charles C *Flora of Indiana* (Indianapolis 1940)
HJ—John Heckewelder's *Journal* of 1792 contained in Heckewelder John *A Narrative of the Missions of the United Brethren among the Delaware and Mohegan Indians* Ed William E Connelley (Cleveland 1907)
SD (1-12)—*Mission Diary, Schönbrunn* (*Ohio*) Nos 1-12 Mission reports periodically sent to the Moravian mother church at Bethlehem Pa 1772-1777 (ms Moravian Archives, Bethlehem, Pa)
TMHS—*Transactions of the Moravian Historical Society* (Nazareth Pa 1858-76 1876- and Bethlehem, Pa special series since 1923)
ZH—Hulbert, Archer B , and Schwarze William N (ed), *David Zeisberger's History of the Northern American Indians* (Columbus Ohio Ohio State Archaeological and Historical Society 1910), reprinted from *Ohio State Archaeological and Historical Quarterly*, XIX (1910)

NOTE The numerous text quotations from *ZH* are in the competent translation of the late Rev Dr William Nathanael Schwarze, former President of the Moravian College and Seminary, and after his retirement, Director of the Moravian Archives, at Bethlehem, Pennsylvania

Occasionally it was necessary to consult the German original of Zeisberger s work, a manuscript volume in the Moravian Archives at Bethlehem —*ACM*

Check List of American Birds 4th edition (*A O U*, Lancaster Pa , 1931)

NOTES

(1) *ZH*, p 7
(2) *Ibid*
(3) 2 Vols 1768
(4) *ZH* p 47
(5) pp 154–173
(6) For scholarly help and advice I am indebted to Dr Edward S Thomas Curator of Natural History, Ohio State Museum Professors Edgar N Transeau and John N Wolfe Department of Botany The Ohio State University and Mr Milton B Trautman Research Associate (Ichthyology) Franz Theodore Stone Laboratory, Put in Bay Ohio —*ACM*
(7) *ZH* p 47
(8) My own translation from the German original *ZH* p 47 reads, "The forests contain mainly oak trees *ACM*
(9) *Busch*, rather unusual for the more common *Wald* *ACM*
(10) *Ibid*
(11) *ZH*, p 51
(12) *ZH* p 163 n 127
(13) *ZH* p 46
(14) *ZH*, p 56f
(15) *ZH* p 48
(16) *ZH* p 57ff and *passim*
(17) *ZH* p 64
(18) *ZH*, p 57
(19) *ZH*, p 14
(20) *ZH*, p 57f
(21) *ZH* p 59
(22) *ZH*, p 59f
(23) *ZH*, p 60f
(24) *ZH*, p 62
(25) *ZH* p 64
(26) *Ibid*
(27) *ZH* p 66
(28) *Ibid*
(29) *Ibid* translation slightly modified —*ACM*
(30) *ZH* p 166 n 189
(31) ' Report on the Birds of Ohio *Rep Geol Survey of Ohio* IV (1882) Pt I p 490
(32) *ZH*, p 66
(33) *ZH* p 69 in the German manuscript of Zeisberger's book (*Moravian Archives*, Bethlehem Pa), the name of the bird is "*die Amsel* unmistakably the [European] Black bird (*Turdus merula* L) *ACM*
(34) *ZH* p 167 n 209
(35) *ZH* p 70 the beginning of the description in *ZH* quoted below has been slightly modified according to the original German —*ACM*
(36) *ZH* p 71
(37) *ZH* p 168, n 224
(38) *ZH* p 71
(39) *ZH* p 72 —Quoted in my own translation since *ZH*, here, is not accurate – *ACM*
(40) *Ibid* —*ZH* translation modified —*ACM*
(41) *ZH*, p 74
(42) *ZH* p 72
(43) *ZH* p 72f
(44) *Ibid*
(45) *ZH* p 74f
(46) *ZH*, p 152
(47) *Ibid*
(48) *ZH* p 173 n 318
(49) *HJ 1798*, p 60f
(50) *ZH* p 47
(51) *ZH*, p 57

(52) *ZH*, p 52
(53) *ZH*, p 46
(54) *ZH*, p 153
(55) *ZH*, p 47
(56) *ZH*, p 153
(57) *ZH* p 57f
(58) *ZH*, p 61f
(59) Zeisberger did not have to go far afield for his observations on beavers and beaver dams A creek in the immediate vicinity of Schönbrunn, even on modern maps bears the name of Beaverdam Creek —*ACM*
(60) *ZH*, p 164, n 160
(61) *ZH*, p 63
(62) *ZH*, p 65
(63) *Ibid*
(64) *ZH*, p 165 n 181
(65) *Ibid*
(66) *ZH* p 65f
(67) *ZH* p 66
(68) *ZH*, p 71
(69) *ZH* p 74
(70) *ZH*, p 73
(71) *TMHS*, Vol I p 192
(72) *Ibid*
(73) *Ibid*
(74) *ZH* p 73
(75) *SD 5*, July 9 1773
(76) *ZH* p 169 n 231 citing S P Hildreth *Pioneer History*, etc (Cincinnati & New York, 1848), p 498
(77) *Ibid*

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Chemical Insect Attractants and Repellents, by Vincent G Dethier 289 pages 69 figures The Blakiston Company, Philadelphia, Pa 1947 Price $5 00

THE NATURAL OCCURRENCE OF "REDLEG," PSEUDOMONAS HYDROPHILA, IN A POPULATION OF AMERICAN TOADS, BUFO AMERICANUS

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The natural occurrence of an epidemic of "Redleg," ***Pseudomonas hydrophila*** (Chester), in a population of American Toads, ***Bufo americanus*** Holbrook, seemed significant for two reasons 1) to the writer's knowledge it is a new naturally occurring host record, and 2) it showed how easily disease is overlooked in the casual observations made by many biologists

It was purely by chance that the epidemic was discovered On March 22, 1948, George H Breiding and the writer visited the lower of two small ponds in lower Donnelly Hollow near Charleston, West Virginia There a large population of American Toads was observed and estimated to be about 300 individuals The toads were mating and were very actively clasping They seemed very tame and could easily be picked up The writer returned the following day to make some photographs of the toads and found the population reduced to about two dozen individuals Many dead toads were seen on the bottom of the pond and on the shore where they had crawled from the water and died

None of the specimens examined showed any mark of violence On March 24, only three pairs of living toads were found and an additional number were found dead The only remaining pair was collected on March 25 This pair had been observed for several days It was unique in that the female was dead when the pair was first observed, on March 23, but the male continued clasping until separated four days later, after being transported to the Ohio State University at Columbus, Ohio

The following day the male died External symptoms and bacteriological tests proved that the disease was "Redleg"

The site of the epidemic was visited again on April 24, 1948 Water samples were taken at both ponds and at three stations two-tenths of a mile apart in the stream which flows from the ponds Blood samples and smears were made from one specimen each of Spotted Newt, ***Triturus v viridescens***, Pickerel Frog, ***Rana pipiens***, and an American Toad tadpole taken from the upper pond and from one specimen of an American Toad tadpole and two Spotted Newts taken from the lower pond

Tests showed that from the upper pond, only the tadpole contained ***Pseudomonas hydrophila***, two water samples and one Newt from the lower pond contained the bacillus, and that the three water samples taken at the stations along the stream were all infected

Bacteria from each positive culture were injected into toads which died subsequently and from whose heart blood ***Pseudomonas hydrophila*** was then recovered

A limited amount of laboratory experimentation was done in which specimens of American Toads and Spotted Newts were placed in aquaria containing water contaminated with ***Pseudomonas hydrophila*** No disease specimens resulted The animals were then injured slightly to provide a means of entry for the bacteria This resulted in contraction of the disease by the toads but not in the newts

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From the foregoing, it was concluded that "Redleg" occurs in nature in American Toads This occurrence would probably only come about during the breeding season during which toads are found in water, the natural habitat of *Pseudomonas hydrophila*, and also the period during which their activity in clasping provides the abrasions which permit the entry of the bacillus into the blood stream

The experimentation might also indicate that the Spotted Newt is an immune species and a carrier of "Redleg" However too little data have been collected to make this a positive assertion

A point of importance is the ease at which this epidemic could have occurred unnoticed had not the pond been visited several days in succession Certainly many similar and many more lesser epidemics of disease frequently occur unnoticed in nature The cases observed and reported are probably, for the most part, chance records as was this one

DISCOVERY OF LIVING METASEQUOIA

SAVE-THE REDWOODS LEAGUE[1]

The genus *Metasequoia* is a conifer which was widely distributed over the northern hemisphere in past ages Its fossil remains (wood, leaves, cones) have been found in Alaska, Greenland, Spitzbergen and northern Siberia, in rocks of Eocene age (60,000,000 years old), in rocks of Miocene age (30,000 000 years old) in Oregon and California, Germany and Switzerland, Manchuria and Japan It was considered to have become extinct, some 20,000,000 years ago, since its fossil remains did not occur in rocks younger than Miocene

About two years ago, reports came from China of the discovery of three trees of *Metasequoia* in a village in the interior One of these living trees was described as large, but no photographs were available, nor was it possible to find out much about it In order to establish the accuracy of this report, and to learn the true nature of these trees, Ralph W Chaney, paleobotanist of the University of California and the Carnegie Institution of Washington, and Milton Silverman, Science Editor of the San Francisco "Chronicle", left San Francisco by Pan American World Airway plane in February, bound for Shanghai and Chungking, from this former capital of China, they proceeded down the Yangtse on a riverboat to Wan Hsien Here they secured baggage porters and sedan chairs, and set out on a journey southward more than a hundred miles into the provinces of Szechuan and Hupeh Traveling over a path largely made up of a rock slab stairway, they covered from 20 to 30 miles a day in rain and fog—a path which crossed four mountain ranges of which two were over 5000 feet high This is a region seldom visited by foreigners—in fact, the remote village at the end of the journey had never before been entered by a foreign visitor The reported presence of hundreds of bandits made necessary extreme precautions to prevent theft of cameras and other essential equipment, an armed guard was necessary during most of the journey

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[1] Based on a statement by Dr Ralph W Chaney Professor of Paleontology University of California, Berkeley, Chairman, Save the-Redwoods League s Education and Interpretation Committee, 114 Sansome St San Francisco 4 California

'Just outside the village of Mo-tao-chi, 70 miles south of Wan Hsien", says Dr Ralph W Chaney, "we came upon the first trees of Metasequoia The largest is nearly 100 feet tall, and 68 inches in diameter above the buttress (almost 11 feet in diameter where the buttress flares out at ground level) It has large branches which extend upward instead of turning downward as in the living redwood, another difference is that *Metasequoia* sheds its leaves in winter, so it was bare at the time of our visit, its bark has a reddish tone suggestive of the redwood, but is much thinner than that of the American tree These and other differences readily distinguish *Metasequoia* from *Sequoia*, but a relationship between the two trees is at once apparent from the similarity of their cones, and their wood is also much the same Preliminary examination indicates that *Metasequoia* may represent the ancestor of the American *Sequoia*

"Continuing southward some 35 miles, we came into a valley occupied by over a hundred trees of *Metasequoia* While none of these are as large as the giant tree at Mo-tao-chi, they are growing on slopes which have not been fully logged off, as is the case farther north Here we were able to study the dawn redwood (*Metasequoia*) under essentially native conditions It grows best beside streams or elsewhere in wet soil, it is not found at elevations far above 4000 feet, for it appears to require mild winter temperature Its associates in the forest are chestnut, sweet gum, oak and birch, all of which trees grow today in many parts of the United States In addition, there lives with *metasequoia* a large tree known as katsura which is confined to northeastern Asia at present All these associates of the living *Metasequoia* had ancestral species growing with the fossil *Metasequoia* in western North America and Europe during the geologic past Here we have a segment of yesterday—a forest which has miraculously survived destruction for a score of million years

"How much longer will *Metasequoia* continue to exist in this central Asian sanctuary? An answer to the question is difficult to give, for in this land of fuel and timber shortage, these great trees of the past are rapidly being cut down by Chinese farmers Some steps must be taken at once if *Metasequoia* is to be saved from extinction during our lifetime, if it is to continue to live on earth as one of the oldest, if not the most ancient forest tree in existence At some time in the near future, an announcement will be made of the plans being made to preserve the *Metasequoia* of Tiger Valley from destruction "

Dr Chaney and Dr Silverman have recently returned to California with specimens of the wood, bark, leaves and cones of these remarkable trees, and with many scientific data which may be expected to aid in solving some of the problems surrounding the age-long survival of these Chinese ancestors of the California redwood

VALIDITY OF THE SPECIFIC GRAVITY METHOD FOR THE DETERMINATION OF THE FINENESS OF GOLD OBJECTS

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The determination of the gold content or fineness of gold objects by means of specific gravity measurements is one of the oldest known methods of assay The account given by Vitruvius of the way by which Archimedes detected the adulteration of the gold in the crown of Hieron of Syracuse shows that the method was known in principle, even if not widely used, before the beginning of the Christian Era There is evidence from Arab sources that it was used in the Middle Ages, and the accounts of the method given in works on assaying of the sixteenth and seventeenth centuries indicate that it was in common use in early modern times It is still used occasionally for the determination of the fineness of gold objects which cannot be assayed or analyzed by the usual dry or wet methods Indeed, the great and unique value of the method is that it makes possible an estimate of the fineness of gold objects, which, because of their great antiquarian or artistic value, cannot be sampled in any way, even for microanalysis In spite of the long time this method has been in use and in spite of its undoubted special value, no critical estimate of its probable accuracy or limitations, apart from brief statements, appears ever to have been published There is considerable evidence that various workers have used this method uncritically and attributed to it an unwarranted degree of accuracy For example, Giesecke (4) determined the specific gravities of a number of ancient electrum coins and then calculated their gold content in two decimal places in percent It can easily be shown that the method does not warrant expressing results to such an apparent degree of accuracy The purpose of the present paper is to indicate its probable degree of accuracy and its limitations

A primary difficulty in the determination of the composition of alloys of gold and silver, or of gold and copper, by specific gravity measurements is that the specific gravities of the pure metals themselves cannot be defined with any high degree of precision Results of even very careful measurements of this so-called constant have varied considerably in accordance with the mechanical and thermal history of the specimens studied Mellor (11) has ably summarized the discordant results obtained by different workers Though the lack of agreement is less when only the most reliable results on massive specimens are considered and still less when mechanically worked metal is alone considered, this being of more practical significance in connection with the kinds of objects ordinarily assayed by the specific gravity method, there is nevertheless apparently no justification for expressing the specific gravities of the pure metals to more than a single decimal place for the purpose of computing the composition of their alloys This means that as a basis for determination carried out at or close to 25° C with reference to the density of water at 4° C the specific gravity of gold should be taken as 19 3, that of silver as 10 5, and that of copper as 8 9 Hence it follows that for the determination of the composition of gold-silver alloys with a possible range of 0 to 100 percent for either component, there are actually available from the difference between the specific gravities of the two metals only 88 possible units in the scale of measurement, each of these units being a tenth of a unit in specific gravity On the average, therefore, a little more than one percent is the closest approach that can possibly be attained in respect to the composition of such alloys by this method Actually if no contraction or expansion occurs on alloying, each tenth of a unit in specific gravity represents a little more than half a percent change in composition near the top of the range in gold content and about two percent change near the bottom of the range Likewise for gold-copper alloys there are only 104 possible units in the scale of measurement, and on the average slightly less than one percent is the closest possible approach to composition that can be attained, with approximately the same differences at the extremes as with gold-silver alloys if no change in volume occurs on alloying These differences at the extremes of the ranges necessarily follow from the nature of the ideal proportional relationship between specific gravity and percentage composition by weight of such binary alloys This relationship may be expressed by the following convenient formula

$$\% \text{ Gold} = \frac{S_1 S_x - S_1 S_2}{S_1 S_x - S_2 S_x} \quad 100$$

Where, on the same temperature basis for each,

S_1 is the specific gravity of pure gold
S_2 is the specific gravity of pure silver or of pure copper
S_x is the specific gravity of a given alloy

A comparison between the ideal figures as computed by the above formula and the experimental figures obtained by various investigators also shows that

TABLE I

COMPARISON BETWEEN ACTUAL GOLD CONTENT OF GOLD SILVER ALLOYS AND THEIR GOLD CONTENT AS CALCULATED FROM THEIR SPECIFIC GRAVITIES

Specific Gravity	Gold Content from Specific Gravity	Actual Gold Content	Difference	Literature Reference
	%	%	%	
19 28	99 9	99 7	+0 2	6
19 17	99 2	99 5	−0 3	6
18 08	91 9	91 7	+0 2	8
18 04	91 6	91 6	±0 0	10
17 93	90 9	91 7	−0 8	6
17 54	88 0	88 0	±0 0	10
16 96	83 6	84 3	−0 7	8
16 35	78 5	78 5	±0 0	10
16 03	75 6	75 0	+0 6	8
15 07	66 5	66 7	−0 2	8
14 87	64 6	64 6	±0 0	10
14 24	57 6	58 3	−0 7	8
13 60	50 0	50 0	±0 0	8
13 43	47 9	47 8	+0 1	10
13 00	42 2	41 7	+0 5	8
12 38	33 3	33 3	±0 0	8
12 26	31 5	31 4	+0 1	10
11 78	23 8	25 0	−1 2	8
11 76	23 5	23 4	+0 1	10
11 29	15 3	16 7	−1 4	8

NOTES ON ORIGINAL DATA

REFERENCE 6 The gold content is given in carats and grains and the specific gravity to three decimal places

REFERENCE 8 The gold content is given in parts per thousand, and the specific gravity as shown

REFERENCE 10 The gold content is given by formula, e g , Ag_4Au, and the specific gravity to three decimal places the method is not any more reliable than about one percent even under the best experimental conditions In Tables I and II are shown comparisons of figures from what appear to be the most careful experiments on record with corresponding ideal figures for gold-silver and gold-copper alloys In order to show up distinctly the differences between the ideal figures and the experimental figures, the specific gravity of gold for this special purpose was taken as 19 30, that of silver as 10 50, and that of copper as 8 90 when calculating the ideal figures from the measured specific gravities, and the ideal gold content is correspondingly given to the first decimal place As explained in the footnotes to these tables, most of the experimental figures were obtained by appropriate recalculation of the original published data so as to place all the figures on a uniform basis for the purpose of easy comparison However, no corrections have been made for the differences in the temperatures at which the specific gravities were measured since the lack of uniformity in this respect apparently would not be enough to affect the first decimal place in the calculated percentages of gold The figures in Table I were all derived from measurements on cast alloys, with the exception of those of the first line, so that there is probably a reasonable degree of uniformity in the physical condition of the gold-silver alloys here compared From this table it is evident that for gold-silver alloys the agreement between the calculated and the actual percentages of gold is fairly good throughout the whole range of composition Nevertheless, individual deviations amounting to around one percent are by no means uncommon From Table II it is evident that for gold-copper alloys the agreement throughout the whole range of composition is not good In part this may be because the measurements of one of the investigators were made on worked alloys, and the other on cast alloys However, if the results on the worked alloys are alone considered (Reference 13), individual deviations approaching one percent are still

TABLE II

COMPARISON BETWEEN ACTUAL GOLD CONTENT OF GOLD COPPER ALLOYS AND THEIR GOLD CONTENT AS CALCULATED FROM THEIR SPECIFIC GRAVITIES

Specific Gravity	Gold Content from Specific Gravity	Actual Gold Content	Difference	Literature Reference
	%	%	%	
18 84	97 9	98 0	−0 1	13
18 58	96 7	96 9	−0 2	13
18 36	95 6	95 8	−0 2	13
18 12	94 4	94 8	−0 4	13
17 93	93 5	93 9	−0 4	13
17 79	92 7	93 2	−0 5	13
17 57	91 6	92 3	−0 7	13
17 35	90 4	91 7	−1 3	8
17 17	89 4	90 1	−0 7	13
16 81	87 4	88 1	−0 7	13
16 48	85 4	86 1	−0 7	13
15 86	81 5	83 3	−1 8	8
14 74	73 5	75 0	−1 5	8
12 69	55 4	58 3	−2 9	8
10 04	21 0	25 0	−4 0	8

NOTES ON ORIGINAL DATA

REFERENCE 8 The gold content is given in parts per thousand, and the specific gravity as shown

REFERENCE 13 The gold content is given to two decimal places in percent Three experimental results are given for the specific gravity of each alloy and the average of these to four decimal places common A more important cause of the general lack of agreement is that when gold is alloyed with copper a change in total volume occurs, this increasing as the proportion of copper in the alloy increases, so that the ideal formula does not strictly apply However, even if a correction is made for this change in volume, individual deviations of around one percent still occur, so that here again the method is not consistently reliable to more than about one percent even under the most favorable conditions

When this method is used for estimating the gold content of actual objects of unknown composition the error may often far exceed one percent for any of various reasons In the first place the mechanical and thermal history of a given object is often unknown so that it may not be easy to determine whether the object is worked or cast More serious is the possible presence of foreign inclusions in the metal, and worse yet the possible presence of hidden cavities Another serious source of error may be a lack of knowledge of the particular metals alloyed with the gold The presence of platinum or other heavy metals of the platinum group, for example, would lead to deceptively high results, though this cannot be considered a common source of error More commonly, if the gold is alloyed with copper alone and it is assumed that it is alloyed with silver, or vice versa, or more commonly still, if it is alloyed with both in some unknown proportion and the assumption is made that it is alloyed with one or the other only, serious errors may arise in the estimation of the gold content of the metal from the observed specific gravity The possible extent of this error from this one important source alone is indicated by the differences in the computed ideal results shown in Table III It will be noted that this source of error is not serious for alloys of very high gold content, but that it becomes increasingly serious with decrease in gold content

TABLE III

MAGNITUDE OF POSSIBLE ERROR WHEN ALLOYING COMPONENT IS UNKNOWN

Observed Specific Gravity	Calculated Gold Content if Silver is Assumed to be the Sole Alloying Component %	Calculated Gold Content if Copper is Assumed to be the Sole Alloying Component %	Difference in Calculated Gold Content %
19 20	99 4	99 6	0 2
19 00	98 1	98 6	0 5
18 80	96 8	97 7	0 9
18 60	95 5	96 8	1 3
18 40	94 2	95 8	1 6
18 20	92 8	94 8	2 0
18 00	91 4	93 8	2 4
17 80	89 9	92 8	2 9
17 60	88 5	91 7	3 2
17 40	87 0	90 7	3 7
17 20	85 4	89 6	4 2
17 00	83 9	88 4	4 5
16 80	82 2	87 3	5 1
16 60	80 6	86 1	5 5
16 40	78 9	84 9	6 0
16 20	77 2	83 6	6 4
16 00	75 4	82 4	7 0

Since a considerable number and variety of natural and artificial gold objects have been assayed or analyzed by standard dry or wet assay methods by previous investigators, who at the same time carefully measured the specific gravity of these objects, the degree of error from all sources likely to be encountered in actual practice may be approximated by an examination of their results. Curiously enough, only thirteen examples could be found where the investigator, himself, had estimated the gold content from the specific gravity and compared the result with the actual content found by analysis or assay. For most of the collected examples shown in Table IV, therefore, the gold content has been computed from the specific gravity and compared with the actual gold content for the first time. All previous investigators who calculated the gold content from the observed specific gravity did so on the assumption that the gold was alloyed with silver alone. But it can be shown that this assumption does not provide the best general basis for estimating the gold content of objects in which the nature and proportion of

TABLE IV

COMPARISON OF GOLD CONTENT OF VARIOUS NATURAL AND ARTIFICIAL OBJECTS AS ESTIMATED FROM SPECIFIC GRAVITY WITH THEIR GOLD CONTENT AS DETERMINED BY ANALYSIS

No	Description	Specific Gravity	Gold Content from Specific Gravity on Given Basis %			Gold Content by Analysis %	Difference Error on Given Basis, %			Literature Reference
			A	B	C		A	B	C	
1	Nugget	19.10	98.8	99.1	99.0	99.0	−0.2	+0.1	±0.0	14
2	Ancient Ornament	19.10	98.8	99.1	99.0	98.0	+0.8	+1.1	+1.0	15
3	Natural Crystal	18.77	96.6	97.6	97.2	95.4	+1.2	+2.2	+1.8	1
4	Nugget	18.67	96.0	97.1	96.6	94.2	+1.8	+2.9	+2.4	3
5	Ancient Wires	18.59	95.4	96.7	96.2	96.9	−1.5	−0.2	−0.7	9
6	Nugget	18.44	94.4	96.0	95.4	94.4	±0.0	+1.6	+1.0	14
7	Native Grains	18.31	93.6	95.4	94.6	94.7	−1.1	+0.7	−0.1	3
8	Natural Crystal	18.11	92.1	94.4	93.5	92.5	−0.4	+1.9	+1.0	1
9	Ancient Bar	18.05	91.7	94.1	93.1	90.7	+1.0	+3.4	+2.4	16
10	Nugget	17.96	91.1	93.6	92.6	91.4	−0.3	+2.2	+1.2	14
11	Nugget	17.84	90.2	93.0	91.9	93.5	−3.3	−0.5	−1.6	3
12	Nugget	17.50	88.4	91.7	90.3	90.8	−2.4	+0.9	−0.5	14
13	Fragment of Ancient Ornament	17.53	87.9	91.4	89.9	88.6	−0.7	+2.8	+1.3	9
14	Nugget	17.48	87.5	91.1	89.6	89.4	−1.9	+1.7	+0.2	14
15	Nugget	17.40	87.0	90.7	89.1	87.4	−0.4	+3.3	+1.7	14
16	Ancient Plate	17.33	86.4	90.3	88.7	88.7	−2.3	+1.6	±0.0	9
17	Celtic Ring Money	17.26	85.9	89.9	88.2	86.7	−0.8	+3.2	+1.5	9
18	Celtic Ring Money	16.90	83.1	87.8	85.9	85.6	−2.5	+2.2	+0.3	9
19	Nugget	16.87	82.9	87.7	85.7	86.8	−3.9	+0.9	−1.1	14
20	Fragment of Ancient Torque	15.69	72.5	80.3	77.1	71.0	+1.5	+9.3	+6.1	15
21	End of Ancient Bracelet	15.50	70.7	79.0	75.6	75.6	−4.9	+3.4	±0.0	15
22	Fragment of Ancient Torque	15.44	70.2	78.6	75.1	79.5	−9.3	−0.9	−4.4	9
23	Ancient Bosses	15.43	70.1	78.5	75.0	74.7	−4.6	+3.8	+0.3	15
24	Fragment of Ancient Torque	15.38	69.6	78.2	74.6	71.5	−1.9	+6.7	+3.1	9
25	Ancient Coin	15.06	66.4	75.9	72.0	69.0	−2.6	+6.9	+3.0	2
26	Ancient Bar	14.83	64.0	74.2	70.0	66.8	−2.8	+7.4	+3.2	16
27	Ancient Coin	14.35	58.8	70.5	65.6	59.8	−1.0	+10.7	+5.8	7
28	Ancient Coin	14.04	55.3	67.9	62.7	69.7	−14.4	−1.8	−7.0	2
29	Ancient Coin	13.85	53.0	66.3	60.8	59.5	−6.5	+6.8	+1.3	2
30	Ancient Coin	13.66	50.7	64.7	58.9	57.9	−7.2	+6.8	+1.0	5
31	Ancient Coin	13.23	45.3	60.7	54.3	57.3	−12.0	+3.4	−3.0	16
32	Ancient Coin	13.07	43.1	59.2	52.5	51.8	−8.7	+7.4	+0.7	16
33	Ancient Coin	12.19	30.4	50.1	41.9	37.9	−7.5	+12.2	+4.0	2

the alloying metal or metals are unknown. It is true that in natural objects of very high gold content, or in objects fashioned from such native gold, silver is often the sole alloying metal, but for such objects of lower gold content copper may also be present in a proportion approaching that of the silver, and sometimes the copper is in higher proportion than the silver. For example, Object No. 5 of Table IV was found by the analyst to contain 2.49% silver and only a trace of copper, whereas Object No. 21 was found to contain 13.03% silver and 11.61% copper, and Object No. 23 to contain 6.22% silver and 19.09% copper. In objects formed from artificial alloys copper is still more likely to be present in high proportion when the gold content is low. It is therefore important to make some allowance for the possible presence of copper in considerable proportion when computing the gold content of objects of low fineness from specific gravity measurements.

As shown in Table IV, the gold content of the various objects has been calculated from the observed specific gravities on three different bases in order to find out empirically the best single general basis for such estimations. For Basis A the assumption is that the gold was alloyed with silver alone, for Basis B that it was alloyed with copper alone, and for Basis C that it was alloyed with equal proportions of silver and copper, all computations being made according to the ideal mixture formula previously given. A slight uncertainty exists in these calculated results since some of the investigators did not state the temperatures at which the specific gravities were measured, and others measured them at different stated room temperatures. However, as found by test calculations, this lack of uniformity in the specific gravity figures can have little effect on the validity of the conclusions.

TABLE V

ANALYSIS OF DATA OF TABLE IV SHOWING DIFFERENCES IN ACCURACY THAT RESULT FROM THE PARTICULAR BASIS SELECTED FOR COMPUTING FINENESS FROM SPECIFIC GRAVITY

Kind of Difference	Range of Actual Gold Content—%	Basis A	Basis B	Basis C
Proportion of Results Nearer to True Value	Over 95	60%	20%	20%
	Under 95, over 90	57%	14%	29%
	Under 90, over 85	43%	14%	43%
	Under 85	36%	14%	50%
Average Error	Over 95	+0.4%	+1.2%	+0.9%
	Under 95, over 90	−0.9%	+1.5%	+0.5%
	Under 90, over 85	−1.8%	+2.2%	+0.6%
	Under 85	−6.1%	+5.9%	+1.0%
Greatest Single Error	Over 95	+1.8%	+2.9%	+2.4%
	Under 95, over 90	−3.3%	+3.4%	+2.4%
	Under 90, over 85	−3.9%	+3.3%	+1.7%
	Under 85	−14.4%	+12.2%	−7.0%

The actual figures for the gold content and the difference error on the three different bases are shown in Table IV, and in Table V a comparative summary of the resulting differences in accuracy is given. It will be seen that when the gold content is very high Basis A yields the best results, but that this same basis yields poor results on objects of low gold content. Basis B gives the poorest results when the gold content is high, and results that are nearly as poor as with basis A when the gold content is low. Basis C yields results on objects of very high gold content that are fairly good, and results on objects of lower gold content that are much better than either Basis A or Basis B. It is evident from all these figures that, of the three, Basis C is the best to use for objects of unknown composition

Of course where the alloying metal is known from qualitative tests to be solely or predominantly silver or copper then Basis A or Basis B should be used Still closer results on objects of unknown composition and of medium to high gold content might be obtained by selecting as a general basis for computation an ideal alloy having a higher proportion of silver than copper, or by using Basis A for objects of very high specific gravity and Basis C for objects of lower specific gravity, but in view of the approximate nature of the results anyway it is doubtful whether much would be gained by introducing such further refinements Table VI, computed on Basis C, provides a convenient means for converting the observed specific gravity to percentage of gold when estimating the gold content of objects by this method

TABLE VI

PRACTICAL CONVERSION TABLE FOR ESTIMATING GOLD CONTENT OF OBJECTS FROM SPECIFIC GRAVITY MEASUREMENTS

Specific Gravity 25°/4°	Gold Content %	Specific Gravity 25°/4°	Gold Content %	Specific Gravity 25°/4°	Gold Content %
19 3	100	16 5	83	13 7	59
19 2	99	16 4	82	13 6	58
19 1	99	16 3	82	13 5	57
19 0	98	16 2	81	13 4	56
18 9	98	16 1	80	13 3	55
18 8	97	16 0	79	13 2	54
18 7	97	15 9	79	13 1	53
18 6	96	15 8	78	13 0	52
18 5	96	15 7	77	12 9	51
18 4	95	15 6	76	12 8	49
18 3	95	15 5	76	12 7	48
18 2	94	15 4	75	12 6	47
18 1	93	15 3	74	12 5	46
18 0	93	15 2	73	12 4	45
17 9	92	15 1	72	12 3	43
17 8	92	15 0	71	12 2	42
17 7	91	14 9	71	12 1	41
17 6	90	14 8	70	12 0	39
17 5	90	14 7	69	11 9	38
17 4	89	14 6	68	11 8	37
17 3	89	14 5	67	11 7	35
17 2	88	14 4	66	11 6	34
17 1	87	14 3	65	11 5	32
17 0	87	14 2	64	11 4	31
16 9	86	14 1	63	11 3	29
16 8	85	14 0	62	11 2	28
16 7	84	13 9	61	11 1	26
16 6	84	13 8	60	11 0	25

It is further evident from Tables IV and V that the method is only reliable for objects of high gold content, and that it becomes increasingly less reliable as the gold content decreases until it becomes very unreliable indeed for objects of low gold content The average error with objects of high gold content approaches one percent, and the error on single determinations may be around two percent, so that even for these the method should be regarded as no more than roughly quantitative From the large errors likely to occur with objects of low gold content it is evident that for these this method yields only a rough estimate of the true gold content

On the basis of all the foregoing considerations there is no point, therefore, in attempting to determine the specific gravity of objects to more than the first decimal place for the purpose of estimating their gold content by this method, nor is there any point in expressing the results to more than the nearest whole number in percent Furthermore, the method should be restricted to objects of a high degree of fineness

TABLE VII

ESTIMATIONS OF THE FINENESS OF SOME ANCIENT GOLD COINS

No	Place of issue	Ruler	Approximate Date of Coin	Denomination of Coin	Specific Gravity	Gold Content %
1	Persia	?	4th Cent B C	Daric	19 0	98
2	"	?	4th Cent B C	"	18 9	98
3	Macedon	Philip II	359–336 B C	Stater	19 2	99
4	"	Alexander III	323 B C	"	19 1	99
5	Carthage	?	277–219 B C	"	13 4	56
6	"	?	277–219 B C	"	13 3	55
7	Roman Republic	Julius Caesar	46 B C	Aureus	19 2	99
8	Roman Empire	Augustus	8 B C	"	19 1	99
9	" "	Tiberius	14–15 A D	"	19 2	99
10	" "	Tiberius	16–21 A D	"	19 2	99
11	" "	Tiberius	21–25 A D	"	19 2	99
12	" "	Claudius	49–50 A D	"	19 2	99
13	" "	Nero	64–68 A D	"	19 2	99
14	" "	Nero	64–68 A D	"	19 2	99
15	" "	Vespasian	69–79 A D	"	19 1	99
16	" "	Titus	74 A D	"	19 1	99
17	" "	Domitian	79 A D	"	19 1	99
18	" "	Domitian	84 A D	"	19 1	99
19	" "	Trajan	100 A D	"	19 2	99
20	" "	Hadrian	117 A D	"	19 0	98
21	" "	Hadrian	119–122 A D	"	19 1	99
22	" "	Hadrian	134–138 A D	"	19 1	99
23	" "	Antoninus Pius	143–144 A D	"	19 1	99
24	" "	Antoninus Pius	151–152 A D	"	19 2	99
25	" "	Antoninus Pius	156–157 A D	"	19 1	99
26	" "	Verus	163–164 A D	"	19 1	99
27	" "	Verus	163–164 A D	"	19 1	99
28	" "	Verus	163–164 A D	"	19 2	99
29	" "	Septimus Severus	193 A D	"	19 0	98
30	" "	Macrinus	217–218 A D	"	19 1	99
31	" "	Maximianus	286 A D	"	19 1	99
32	" "	Maximianus	288–289 A D	"	18 7	97
33	" "	Diocletian	287 A D	"	19 1	99
34	" "	Diocletian	290–292 A D	"	19 0	98
35	" "	Diocletian	296 A D	"	19 1	99
36	" "	Diocletian	296 A D	"	19 2	99
37	" "	Constantius II	337–361 A D	Solidus	18 8	97
38	" "	Constantius II	337–361 A D	"	18 4	95
39	" "	Jovian	363–364 A D	"	18 3	95
40	" "	Valentinian I	364–375 A D	"	19 0	98
41	" "	Valentinian I	364–375 A D	"	18 2	94
42	" "	Valens	364–378 A D	"	18 5	96
43	" "	Valens	364–378 A D	"	18 4	95
44	" "	Gratian	375–383 A D	"	19 1	99
45	" "	Theodosius	379–395 A D	"	19 0	98
46	" "	Honorius	395–423 A D	"	19 0	98
47	" "	Honorius	395–423 A D	"	18 7	97
48	" "	Valentinian III	425–455 A D	"	18 8	97
49	" "	Valentinian III	425–455 A D	"	18 7	97
50	" "	Julius Nepos	474–475 A D	Triens	17 8	92

As an example of the proper application of this method and its utility where other methods are not applicable, there are shown in Table VII results obtained by the writer on a group of 50 ancient gold coins With one exception, these coins were all from the numismatic collection of the Princeton University Library, and the writer hereby acknowledges his indebtedness to Professor S H Weber, former Curator of Special Collections of that library, for his kindness in loaning these rare and valuable coins for the purpose of obtaining the results here recorded The one exceptional coin, No 2 in Table VII, was found during the excavation of the ancient Agora at Athens, Greece, and was examined by the writer at that site The specific gravity of these coins was determined by the method of Archimedes, the coins being suspended from the arm of an analytical balance by means of a very fine platinum wire and weighed first in air and then in distilled water at 25°C The gold content was found from the specific gravity by the use of the data now shown in Table VI

From Table VII it will be seen that, with two exceptions, these coins were found to contain over 90% gold, and the great majority over 95% gold Two coins, Nos 5 and 6 in the table, were found by this method to contain only 56% and 55% gold, respectively, and in accordance with the previous discussion these two figures must be regarded as mere approximations that may be 5% or so from the truth Nevertheless, these results are useful as showing the much lower fineness of these two coins as contrasted with all the others in this group It is likely that all the other results are not more than 1% or 2% off from the true values The fact that results on duplicate coins of the same ruler generally agree well with each other is an indication, at least, that the figures are essentially correct An independent, though indirect and random, check on the essential correctness of the very high results for the gold content of the Roman coins is given by some figures published by Rauch (12) on the percentages of gold in a few Roman coins as obtained by fire assay He reports that a coin of Nero contained 99 3% gold, which is close to the two results of 99% here obtained on coins of this same ruler For a coin of Titus he gives 99 6% which is in fair agreement with the 99% found here On a coin of Verus he gives 99 0% which agrees with the three results of 99% here obtained on coins of this emperor It appears likely, therefore, that a considerable degree of confidence may be placed on the very high results shown in Table VII for the gold content of the Roman coins

The uniformly very high gold content of the coins in the long series of Roman Imperial coins from Augustus to Diocletian, extending over a period of some three centuries, is remarkable Since only occasional small specimens of native gold of such a high degree of fineness have been found in any part of the world, the occurrence of any ancient deposit of gold of this quality large enough to furnish directly the gold required for this extensive Roman coinage seems very improbable It is much more probable that the gold which entered into these coins came from a number of different sources at different times, and that such gold was not only of a lower degree of fineness in general, but that it also differed considerably in gold content The inescapable conclusion seems to be that the Romans knew and applied a highly efficient process for the purification of the native gold that entered into their coinage, and that they were also able consistently to produce purified metal of a very high degree of fineness The slightly lower average gold content and the less uniform gold content of the Roman coins of the fourth and fifth centuries may be an indication of some loss in technical knowledge and skill, though this decrease in quality may be economic in origin In general, these experimental results are of significance for the history of metallurgy as indicating the high degree of knowledge and skill in the metallurgy of gold extant in Roman times The few similar high results for the gold content of the coins of ancient Persia and of Macedon may be an indication of the much earlier existence of a similar degree of metallurgical knowledge and skill

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Mineral Nutrition of Plants and Animals

Frank A Gilbert, University of Oklahoma Press Norman 1948 131 pages illustrated

This small book sponsored by the American Petroleum Institute, and written by one of the botanists of the Battelle Memorial Institute of Columbus, possesses the virtues of brevity and forthrightness It contains recent references to work in scattered experiments conducted in agricultural institutions over the country It is of that handy size to be a ready reference book on the desk of a teacher or student and also presents a bibliography of 329 entries A suggested improvement is the addition of a discussion of the synthesis of amino acids in plants and the foundation of proteins in both plants and animals This could be accomplished without much more than a few pages of text if presented in the style of the present text Additional information on the trace elements would also add greatly to its value —*A E Waller*

A NEW NAME FOR A SPECIES OF SCAPHOIDEUS PREVIOUSLY PLACED UNDER THE NAME LUTEOLUS V D

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In 1894 Van Duzee[1] described a species of *Scaphoideus* which he named *luteolus* Four specimens in the original series, one female and three males were from Anglesea, N J and New York City Apparently two species were included in the original type series and no holotype was designated The species was interpreted by the older Hemipterists, Van Duzee, Osborn and Ball, as the species treated by DeLong as *luteolus* in 1948[2] In 1947 Oman[3] examined the leafhopper types in the Van Duzee collection at the Iowa State College and designated the only female of the series as the lectotype—the females of this group have no distinctive differential morphological characters The male (*allotype*) is apparently another species The specimen selected is representative of a species described by DeLong and Mohr as *baculus* in 1936 This leaves the species formerly known as *luteolus* without a name for which *Scaphoideus motus* is proposed

Scaphoideus motus n sp

Resembling *immistus* in general form, but with basal two-thirds of elytra more uniformly brown and with distinct genital structures Length 4 4 5 mm

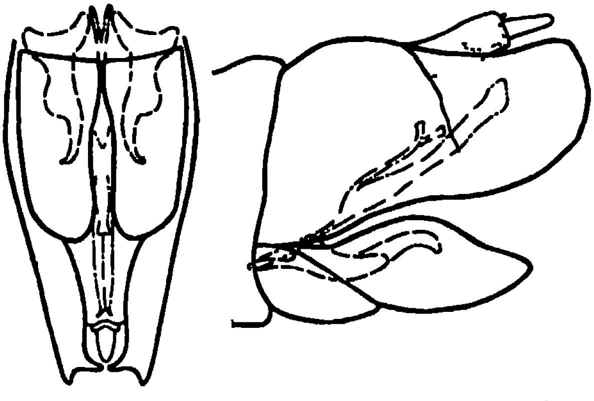

FIG 1 Lateral and ventral views of the male genital structures of *Scaphoideus motus*

Vertex bluntly produced, a little wider between the eyes at base than median length

Color *Vertex* white, marginal line heavy The fuscous band between the eyes is broad, width almost half the length of vertex, medially produced *Pronotum* almost uniformly brownish Scutellum brownish fuscous anteriorly, paler posteriorly *Elytra* brownish fuscous, veins brown, reflexed costal veinlets, apex of each elytron, and apical veins brownish, small white areolar spots just before and also posterior to cross nervures of apical cells

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Female seventh sternite roundedly produced, with a short V-shaped notch at apex. Male plates broadly rounded at apices. Aedeagus in lateral view broadened at one-third its length, somewhat narrowed at two-thirds its length, and again broadened to the enlarged apex, which is produced dorsally and bluntly pointed dorsal process slender with two long slender bifurcate teeth The pygofer is characterized by a small tooth on the apical caudal portion on each side

Male *holotype* Hummelstown, Pa , July 6, 1919, J N Knull Allotype female, New Haven, Conn , July 29, 1920, by W B Walden, and female paratypes from Clarkesville, Tenn , July 9, 1916, DeLong, and Reading, Pa , July 9, 1918, and male paratype from New Bremen, Ohio, July 18, 1927, DeLong Male and female paratypes from Illinois in the Illinois Natural History Survey collection are from Alton, June 26, 1934, Ashley, Aug 17, 1917, Cedar Lake (in bog), Aug 6, 1906, Havana, July 2, 1934, Meredosia, Aug 20, 1917, Monticello, June 11, 1934, Pana, July 21, 1937, Urbana (on cottonwood), July 12, 1920 and Aug 11, 1932

REVIEW OF LITERATURE ON FACTORS AFFECTING BOBWHITE QUAIL (COLINUS V VIRGINIANUS) POPULATION FLUCTUATIONS[1]

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The cause of the present low in bobwhite quail populations in Ohio is a very controversial subject Many reasons have been advanced to explain the periodic fluctuations that occur in bobwhite populations in this state It is the purpose of this paper to discuss and attempt to evaluate these reasons Of the many articles reviewed by this writer only a selected few have been used as references to avoid repetition and in order to eliminate unsound conclusions

According to Leopold (1) the history of bobwhite populations in the north central states can be subdivided into four stages

1 A pre-settlement stage during which it was likely that quail were restricted to the open edges of prairies and open woods

2 A crude agricultural stage, a period where good interspersion of grain, brush, weeds and hedges made possible the extension of the birds' range and stabilized the population

3 An intensified agricultural stage which was accompanied by a decrease in quail numbers "frequently due to overshooting, and nearly always due to a decrease in the area of habitable range "

4. A stage of agricultural depression, good roads, and automobiles

Leopold mentions that the third stage began as early as 1875 in some regions and as late as 1905 in others Severe fluctuations in bobwhite quail numbers in some areas were evident long before the third and fouth stages were firmly established (2, 3, 4, 5, 6, 7)

Various factors have been ascribed as the major causes of bobwhite population fluctuations—exposure, starvation, drought, predation, inbreeding, migrations, and competition Reference to severe winters as a cause for the periodic reduction of quail is quite common in the literature (2, 4, 8 9, 10, 11) Even as early as 1782 De Crevecoeur (8) reported a severe winter that reduced the bobwhite to near extinction in the East Scott (12) states that

> 1 Reasonably healthy Bobwhites may perish through imprisonment by drifting snow
>
> 2 Exposure to cold, high winds and snow may kill reasonably healthy Bobwhites

It is apparent that the phrase "reasonably healthy Bobwhites" may be applied to birds with avitaminoses of such a slight degree as to be vulnerable to climatic severities and yet not noticeable to the human eye Leopold (4) also reports "fat well-fed quail as having died in numbers " Trautman's (13) investigations in Ohio indicate that

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[1] This paper was written while on a research fellowship granted by The Ohio Cooperative Wildlife Research Unit The Ohio State University The Ohio Division of Conservation and Natural Resources, The Fish and Wildlife Service and The Wildlife Management Institute cooperating I am indebted to C A Dambach and D L Leedy for their helpful criticisms in the preparation of this paper

1 An important factor in reducing the bobwhite breeding population in Ohio is the inability of the bird to obtain sufficient food during the stress periods of winter

2 In every winter some mortality from starvation and exposure occurs

3 High mortality among bobwhites occurs in freezing weather following severe sleet storms or during heavy snows

4 The heaviest mortality occurs where clean farming is practiced and cover is deficient

5 Mortality during very severe storms occurs even on farms where normally cover and food are abundant

The destructiveness of winter weather is also emphasized by Allen (14) who states

> It seems justifiable to conclude that snow and ice are the most destructive climatic agents to the bobwhite quail on the northern edge of its range They operate either by cutting off the birds food supply or by killing them directly when accompanied by strong winds and low temperatures It is the exceptional years which kill the quail and it has been estimated that such a winter in the north central region can be expected every 4 to 7 years

The ability ot the bobwhite to withstand such environmental hardships as food shortages and exposure is very low as compared with other game species (the quail is classified as a song bird in Ohio), notably the ring-necked pheasant and wild turkey (15) Gerstell (15) stressed covey size as a factor in winter survivability The bobwhite's ability to withstand lack of food was low as compared with that of other game birds (15) The results of fasting tests show that the maximum survival was less than one week even at high temperatures, at lower temperatures the survivability averaged only several days In relation to the above Gerstell (15) states

> In this connection it must be remembered that both observations in the field and tests performed in the laboratory have revealed the fact that even under favorable food conditions the bobwhite suffers mortality as a result of exposure to environmental extremes

During the winter of 1935–36 on an area in Pennsylvania where winter feeding was carried on, high mortality occurred and over 90 per cent of the bobwhite perished (15) Nestler and Langenbach (16) state that extreme temperatures alone may not be the only cause of bobwhite mortality during severe winters Their results showed that under controlled laboratory conditions no deaths of bobwhite quail occurred during sub-zero temperatures, whereas nearly all mortality during the experiments occurred during or immediately following abnormally heavy and prolonged rain-storms Errington's (17) field observations apparently confirm these observations

> Native northern bobwhites, if well fed and in prime condition, usually with stand most low temperatures occurring within their range Many of my field notes deal with populations surviving air temperatures lower than 15° below zero (F)

Drought in this region appears to be of minor significance in determining the general trend of bobwhite populations, although no definite proof is possessed Errington (18) reports that if drought is extreme enough, it may cause a possible wholesale loss of eggs, partly because of egg spoilage after premature incubation and partly because of desertion

The effect of cover on the carrying capacity of a quail range seems to be fairly well established (19) Cover may operate as the limiting factor during severe fluctuations of bobwhite quail populations in some areas (13) It is entirely possible, too, that a lack of suitable cover may play a role in the effect of severe winters—a stepping stone to severity

Predatory pressure has often been assigned first place as the explanation of lows in game populations This is especially true at the present time in Ohio due to the low number of game species and the high fox population (*Urocyon cinereoargenteus* and *Vulpes fulva*) Errington's (18) observations indicate that predation plays a major role in reducing populations only when the carrying capacity of the range is exceeded Relatively high bobwhite populations have been maintained in sections of unglaciated Ohio, which also maintain a high fox population, in other sections, portions of glaciated Ohio, where there have been few or no foxes, the bobwhite have been relatively scarce

Increased numbers of pheasants and Hungarian partridges may have affected the population of native bobwhites Errington's (20) observations support this view Although in northwestern Ohio an increase in pheasant populations occurred concurrently with a decline in bobwhite numbers and with a decrease in diversified farming of the land, there appears to be no clear relationship between the pheasant population and the severe decline in bobwhite numbers in that area

The laymen in Ohio often express the belief that quail at the present time are smaller than in previous years and that this decrease in size and also in numbers is the result of inbreeding Weight studies conducted by the author (unpublished) and by Trautman (21), on Ohio bobwhite show that the weight of quail in the state varies with locality and that the birds are as large in size in each locality as they were many years ago Aldrich (22) mentions the possible effect of lowering survivability of native stock by inbreeding with introduced birds foreign to the region The bobwhite quail in Ohio has been classified as a songbird since 1917 Very few releases of quail have been made since that time Where releases have been studied they appear to have been unsuccessful (23) The small number of releases and the low survivability of released birds may eliminate the effect of inbreeding with foreign birds Research by Nestler and Nelson (24) on inbreeding in pen-raised quail indicates

> "that close inbreeding of quail can have deleterious effects on reproduction "

Relatively high quail populations in various sections of unglaciated Ohio and the occurrence of the "fall shuffle" tend to eliminate the effect of inbreeding in native populations However, in areas of low populations as in portions of glaciated Ohio, a fall shuffle may not be effective in the prevention of inbreeding (i e the coveys are so far apart that a mixing of coveys do not occur as a result of the fall shuffle) In a region of this type inbreeding over a period of time may therefore reduce reproduction and thus the total population

The fact that birds of normal weight have been known to freeze despite reports (16, 17) of their tolerance to extremes of temperature under field and laboratory conditions indicates that death by freezing may be due to a change in the normal physiological condition of the birds This change may be due to a dietary deficiency or the inability of this species to survive near the edge of its northern range Nestler (25) suggests that a vitamin A deficiency may be a cause of the fluctuation in quail populations on their northern range A study conducted by the author (26) indicated that a vitamin A deficiency during the winter of 1946–47 in Ohio was not a limiting factor in bobwhite quail populations

It appears from the preceeding discussion that the cause of bobwhite quail population fluctuations in Ohio is unknown These fluctuations are probably not due to any one factor but are the result of interactions of many factors

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THE OHIO JOURNAL OF SCIENCE

VOL. XLIX MAY, 1949 No. 3

ANTHROPOLOGY AND HUMAN GROWTH

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There is nothing new about the study of man by man. Man has been observing and commenting about himself for a very long time. In fact, we may suspect that even the earliest torch-bearers of man's progress had an interest in their fellow-creatures—a gastronomical interest. One of man's first discoveries about man probably was that he is edible.

Some epochs later, when dietary habits changed, to be replaced by other equally fascinating and destructive fashions, man's interest in himself had not abated. Still, even among non-predatory anthropologists, the chief motif usually was man as a palaeontological curiosity, man as a racial specimen, man in the mass—seldom the study of man as an individually developing organism.

It was not until well into this century that any considerable body of anthropologists tore themselves away from the absorbing study of defunct individuals, and became aware of the living laboratory awaiting them in the growing human body. In this movement, the names of Franz Boas and C. B. Davenport are outstanding.

A dawning realization that the human child is not merely a little man, but an organism possessing peculiar problems and challenges, turned the attention of many other disciplines to the growing human being as an individual object of study. Such a trend may be seen early, for instance, in the establishment of pediatrics as a separate medical specialty, and in the increasing interest of psychology in problems of child development. Many such fields came into the orbit of human growth as full-blown disciplines, intent upon their own problems, and employing children as subjects only insofar as they were suitable to the study at hand. These fields often remained to study human growth and development as a discipline in its own right.

And in the report of the anthropology section of the A. A. A. S. at its 1931 meeting, human growth may be considered, so to speak, to have come of age.

> "In the realm of physical anthropology emphasis centered very largely around the question of growth. . . . Indeed, the sessions devoted to this subject left a rather definite impression that we may be at the beginning of a new era in which the individual, rather than mass studies, will be foremost. The importance of observing the same individual over the largest possible period was emphasized by nearly every speaker who dealt with any aspect of development."

In the course of this evolution, research has thus tended to shift its interest from the study of a few variables in large samples of humans, at one period of time, to the study of many variables in relatively small samples of humans, over long periods of time In other words, anthropology has become aware of the ontogenetic aspects of the story of man, and aware also that the observation and analysis of human growth present valid anthropological problems (1–4)

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[1] Associate professor of anthropology, Antioch College, and chairman physical growth department, Fels Research Institute for the Study of Human Development, Yellow Springs, Ohio. From a speech given at the 57th Annual Meeting of the Ohio Academy of Science, University of Toledo, May 7, 1948.

The study of human growth gives rise to problems which have an existence within themselves, and call for methods of analysis which are distinctive (5–9) This situation arises in part from the fact that man himself is in many respects a unique animal

Man has certain structures and physical abilities which, though not unique in a broad biologic sense, are nevertheless at the extremes of a continuum For example, one easily thinks of brain size, habitual upright posture, language, tool-using hands Together with these, man has certain growth patterns of infancy and adolescence, and a life-span extending well beyond the reproductive necessities of the species, which make for unusual person-to-person associations In addition, man has certain environmental relationships which are not completely duplicated by the rest of the biologic world

These environmental relationships have been penetratingly discussed by Frank (10), who distinguishes four types geographical, internal, the cultural environment of group life, and the social environment of group living Human beings operate within these environments, responding in terms of their own "private worlds," through their own inherited physical makeup

In this inter-relation of behavior to biological characteristics, man is essentially unique, and must be studied by methods particularly suited to his own uniqueness We must, as Romanell (11) says, find some kind of an explanation of evolution that will fit all the facts of life, and yet make intelligible the difference between the life of man and the rest of living things Human conduct is not always rational, but there may be a rational interpretation for its irrationality Greff, director of medical sciences of the Rockefeller Foundation, says "some new organizations of researchers must be evolved to carry on those studies of human phenomena which require years to complete We have had a foretaste of such studies in the researches on child growth and development In this field the tendency has been steadily to extend the period under which the individuals are under study"

Since 1929, the Fels Research Institute for the Study of Human Development, at Antioch College, has been engaged in just such a study as Dr Greff has asked for The Institute is engaged in what may be called a longitudinal, multidimensional, integrative study of a relatively small sample of the human population The growth, development and social adjustment of some 300 children, together with their families, are being followed from fetal life through maturity The complexity of such a study makes it necessary, of course, that many disciplines contribute their skills, and the present personnel includes representatives from anatomy, anthropology, biochemistry, genetics, medicine, physiology and psychology (12)

The general program involves an extensive battery of observations, measurements and tests, within the above-mentioned areas, at repeated intervals, through the life-span Within the physical growth department, the collection of data and the core of research are centered around changes in body structure, growth progress and health Thus, techniques and investigations in this department draw heavily upon the disciplines of physical anthropology and medicine The staff of the physical growth department includes a pediatrician, a physical anthropologist, a specialist in the growth of teeth and jaw, and various assistants trained in x-ray and medical techniques, anthropometry and nutrition analysis The point of view of the department is strongly longitudinal, that is, analyses are based on repeated measurements and observations of the same individuals during the entire period of growth

The longitudinal method of studying the development of human beings possesses both advantages and disadvantages (13) A full discussion of these factors is beyond the scope of the present paper However, it is safe to say that, with the materials we have examined to date, longitudinal data appear to give much superior information on growth trends for every physical, physiological, mental and social factor which we have been able to measure or assay

The longitudinal method of studying human development has been cited as the outstandingly important item in predictions of trends of research in the second half of the twentieth century The manipulation of research in this complex area is a procedure in which the anthropologist is truly a key man Within this area, research in physical growth is a vital part in man's search for greater knowledge of himself

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VAPOR PHASE ESTERIFICATION OVER SODIUM ACID SULFATE[1]

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INTRODUCTION

The esterification reaction of acetic acid with ethyl alcohol, as shown by the equation,

$$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

has long excited the curiosity of chemists and has been studied extensively by both organic and physical chemists. The reaction has been one of the most useful in preparative organic chemistry, a classical example of the law of mass action, and one of the baffling problems in homogeneous catalysis.

Berthelot and St. Gilles (1) obtained experimental results in 1862 from which a value for the liquid equilibrium constant was later determined. The value of 4.0 calculated from their data, is still quoted to students studying the problem of reaction equilibrium, although it is known that this K value will vary depending upon the starting proportions of the reaction mixture.

The vapor phase equilibrium value, unlike the liquid phase "constant," should be very nearly a constant for a given temperature throughout an entire range of possible starting compositions. However, the works of the various investigators have yields results from which a true constant for a given temperature cannot yet be deduced. The principal results on vapor phase esterification are now described.

Edgar and Schuyler (2), in 1924, made the first definite attempt to determine an equilibrium constant for the vapor phase reaction. They analyzed the vapor above a liquid equilibrium mixture of alcohol, acid, ester, and water. Their values varied from 347 to 559 for a vapor phase temperature range of 72.6° to 77.6° C.

In 1928, Swietoslawski and Poznanski (3) repeated this work, but with somewhat greater accuracy. Their average numerical value for K at 75° C. was reported as 59 ± 10.

Tidwell and Reid (4) published results of esterification experiments, which showed the value of the equilibrium constant increased as the temperature of the reaction mixture decreased. Their runs were made at fifty degree intervals from 150° to 300° C. The experimental data were obtained from equilibrium runs made over silica gel as the catalyst.

In 1932 Essex and Clark (5) determined the equilibrium constant over silica gel at 150°, 165° and 200° C. Their final values for K were arrived at after allowing for association of acetic acid in the vapor state.

The results for the equilibrium constants obtained by Essex and Clark and by Tidwell and Reid are shown in Table I.

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[1] Presented at the meeting of the Ohio Academy of Science, Toledo, Ohio, on May 7, 1948.

[2] Presented as a thesis in partial fulfillment of the requirements for the Master of Science degree.

TABLE I

T° C	Essex Clark	Tidwell Reid
150	33 0	30 9
165	26 4	
200	16 1	24 9
250		12 7
300		8 9

The values obtained by both sets of investigators check rather well at low temperatures but tend to diverge at high temperatures

Jatkar and Gajendragad (6), 1937 carried out esterification experiments at 230° C and 260° C At 260° C their K value averaged 10, and at 230° C the values round ran from 9 9 to 12 These values, when checked with Table I appear to coincide rather favorably

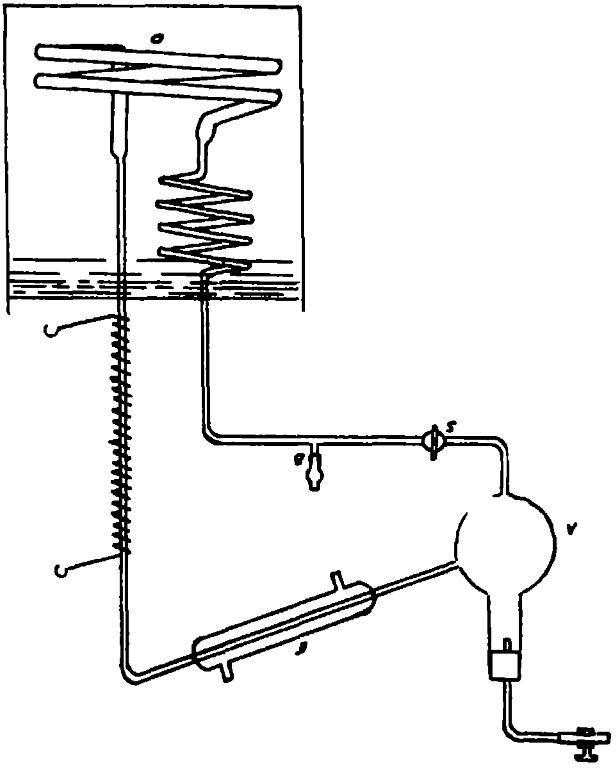

Fig 1 Equilibrium apparatus

Reports of vapor phase esterification experiments carried out at 40° C by Halford and Brundage (7) appeared in 1942 Their final K value of 122±3 was the first to have been calculated from data collected at such a low temperature

In 1943 Knox and Burbridge (8) reported an equilibrium constant for 125° C This work was the first to be done on catalytic esterification below 150° C, and the K value so obtained was 45 7±1 4 The catalyst used was zirconium oxide

A review of existing literature, then, shows that measurements of a number of the earlier workers produced results which in many cases coincide rather well and appear to have considerable merit for the temperature range in which their investigations were carried out If these same results are extrapolated to 100° C, the approximate values for the equilibrium expression vary from as low as 45 to as high as 90 This wide range of values indicates the desirability of considerably more work to be done on the problem

It was the purpose of this work, therefore, to obtain data at 100° C from which the value of the equilibrium constant could be calculated The catalytic agent used for the vapor phase runs was sodium acid sulfate

TABLE II

Esterification sample ethanol 63 17%, water 31 014%, ethyl acetate 4 154%, acetic acid 1 666%

Hydrolysis sample ethanol 62 67%, water 30 768%, ethyl acetate 6 623%, acetic acid 0 000%

Equilibrium Data at 100° C

Run	Time (hrs)	Reaction	Wt % Original Acid	Wt % Final Acid	K Value
1	20	E	1 666	0763	75 26
2	22	E	1 666	0796	72 08
3	16	E	1 666	0803	71 47
4	10	H	0 000	0801	71 84
5	8	H	0 000	0832	69 24
At 125° C					
1	9	E	1 666	1163	48 90
2	8	E	1 666	1203	47 29
3	5	H	0 000	1218	48 65
4	6	H	0 000	1180	48 33

EXPERIMENTAL WORK

The materials used were commercial 95% ethyl alcohol, glacial acetic acid, anhydrous ethyl acetate, and distilled water The catalytic agent was suspended on glass beads The beads were coated with sodium acid sulfate by immersing them in the molten salt

The apparatus used in this work was patterned after one designed by Knox and Burbridge (9) A diagram of the equipment is shown in Figure 1

The constant temperature bath consisted of a 15 liter pyrex glass container The liquid used in the bath was dibutyl phthalate

The bath was provided with an electric stirrer, and the temperature was thermostatically controlled to within one degree

The flask "A," the reaction mixture container, was capped with a one-holed rubber stopper from which extended a small piece of glass tubing The tubing was tiped by a piece of rubber tubing which could be closed by a screw clamp

The reaction mixture was allowed to flow slowly through the stopcock "S" into the preheater "C" The sample was here vaporized and allowed to pass into the reaction coil

This coil was constructed from four feet of twenty millimeter pyrex glass tubing and wound into a continuous coil This tube contained the catalyst

From the reaction coil the vapors passed into the condenser "E" and finally back into the flask "A " To prevent excessive condensation of the vapors between the bath and the condenser, the tubing from "D" to "E" was wrapped and heated with No 20 chromel wire

Thus the system prepared was a closed one and did afford an opportunity for continuous circulation without the loss of any reactants

The hydrolysis and esterification samples were prepared by weight and the percentages of acid and ester were checked volumetrically using standard NaOH and standard HCl The reaction mixtures were stored in an electric refrigerator, and the acid content was checked at intervals to note any change in the sample

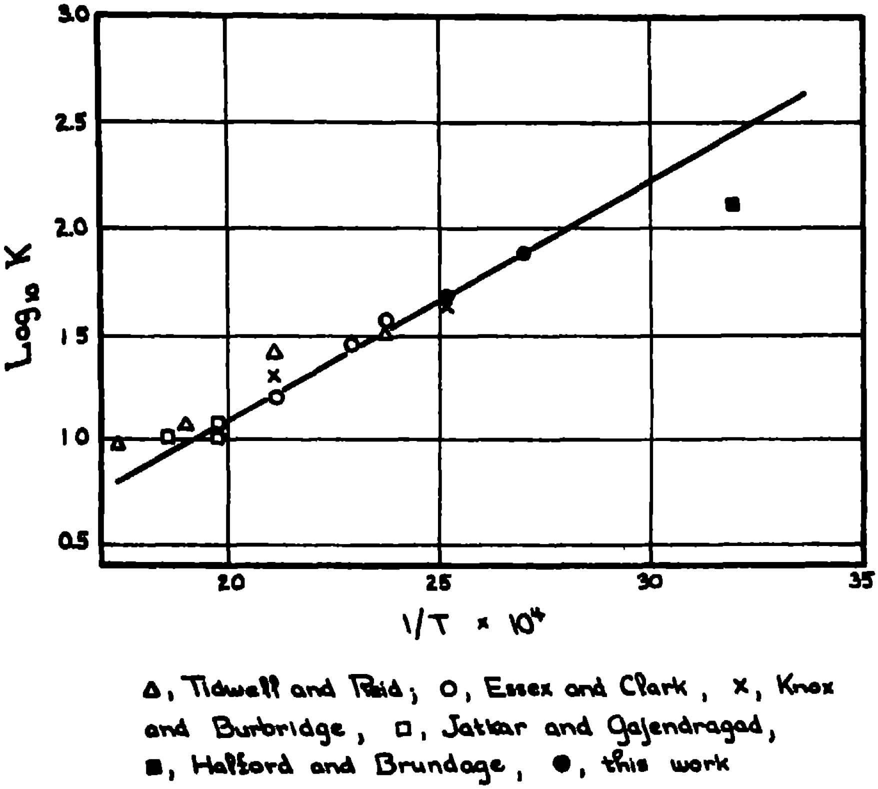

FIG 2 Vapor Phase Esterification Equilibrium

The compositions of the esterification and hydrolysis samples are given in Table II At the beginning of a run, the sample was introduced into flask "A," and the screw clamp was left slightly open The stopcock "S" was opened, and the sample was vaporized, catalyzed and condensed As soon as the first vapors reached the condenser the screw clamp was closed and the reaction mixture allowed to circulate for several hours

After some time, approximately a one gram sample was pipetted from the reaction mixture, weighed and titrated against N/100 NaOH

Circulation of the main sample was begun again and continued for at least another four hours When the acid content became a constant equilibrium was assumed to have been reached

At 100° C equilibrium was reached in about twenty hours and the acid content was very near 0 08%, while at 125° C reaction time was nearer twelve hours and the acid content, 0 12%

From the data of Table II, and after allowing for the association of acetic acid to the dimer, using experimental results of Ritter and Simon (10), the average K values for the vapor phase esterification equilibrium reaction were found to be 74 5±3 3 at 100° C and 48 2±1 3 at 125° C

The results of this investigation are shown on Figure 2 in the form of a plot of the log$_{10}$K against the reciprocal of the absolute temperature The data here obtained are extrapolated to both higher and lower temperatures and compared with the previous investigations

From the extrapolation to higher temperatures, it can be seen that all the results of Essex and Clark are closely approximated At 150° C our theoretical value checks almost exactly the actual value obtained by Tidwell and Reid At 250° C, however, our result more nearly checks those of Jatkar and Gajendragad

When the results of this investigation are extrapolated to a lower temperature, namely, 40° C, our theoretical value diverges sharply from previous data However, it should be pointed out that we have plotted only average values

It appears that it would be desirable to obtain more values especially at lower temperatures

Nevertheless, the close approximation of extrapolated values of this work to experimental values of higher temperature work, makes one feel that the value obtained for the equilibrium constant at 100° C is a creditable one

It might also be pointed out that the results of this investigation at 125° C coincide well with the K value obtained by Knox and Burbridge at the same temperature

SUMMARY

1 The vapor phase esterification reaction for dilute solutions of ethyl acetate and acetic acid in a predominantly alcohol-water solution over sodium acid sulfate has been studied by a static method at 125° C and 100° C

2 At 125° C the K value of 48 3±1 2 was obtained and is in fair agreement with Knox and Burbridge as well as the extrapolated values of earlier workers

3 At 100° C the value of 74 5±3 3 was obtained

4 Sodium acid sulfate was found to be a suitable catalyst at the temperatures at which this work was carried out Its catalytic action appeared to be much more pronounced at low temperatures than the action of silica gel or zirconium oxide used by some previous investigators

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THE EFFECT OF FUNGI ON THE FLAVOR AND COLOR OF TOMATO JUICE

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INTRODUCTION

Many organisms impart a characteristic off flavor to various food products L B Jensen (1) has classified bacteria causing musty flavors on different food products He states they have never observed molds as the causative agents of true mustiness in foods

Mold counts are officially employed to determine adulterations in many food products As commonly used they are also assumed to indicate the general sanitary conditions of the plant High mold counts would indicate unsatisfactory sanitation More should be known about the actual effects of microorganisms on the quality of the products

The effects of fungi and yeast on the flavor of tomato juice were studied to determine whether the use of a highly infected raw product would produce noticeable differences in the flavor of the canned juice

Some of the organisms were grown with reduced oxygen supply to approximate conditions encountered in commercial canning

METHODS

Twenty-eight molds and yeasts (see Table I) were obtained from Dr M D Heise[1] and Dr W D Gray[2] All the available tomato pathogens were selected including ***Rhizopus nigricans***, ***Rhizoctonia*** sp , ***Fusarium*** sp ***Colletotrichum*** sp , and ***Alternaria*** sp The remaining organisms were chosen as possible contaminating agents from the air

One hundred ml of a commercial brand of Ohio tomato juice were pipetted into 250 and 125 ml Erlenmeyer flasks The flasks and juice were autoclaved for 15 minutes at 10 lbs pressure The smaller flasks were used to determine the effect of a reduced oxygen content on the growth since after the addition of the juice to the flask an air space of one half inch remained, leaving only a small surface area exposed to the atmosphere The juice was inoculated with the organisms and the tests and uninoculated controls run in triplicate The samples were incubated at room temperature After a week of incubation 10 ml of the juice from each flask were removed and autoclaved An Abbé refractometer reading was made pH determined by a Beckman potentiometer and the flavor, odor and color of each sample were recorded The flasks were incubated for a total of five weeks and the determinations made weekly

RESULTS

The results of weekly determination of pH refractive indices and the final odor flavor and color are recorded in Table I The organisms in the 250 ml flask produced a greater growth with greater changes in pH, refractive indices, color, odor and flavor than those grown in the 125 ml flasks The rate of the physiological changes was greatly decreased in the smaller flasks With the weekly removal of 10 ml of the juice larger surface areas were exposed so that by the fourth and fifth week the difference in growth in the small vs large flasks was less pronounced

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[1] Bacteriology Department, Ohio State University
[2] Botany Department, Ohio State University

TABLE I

EFFECT OF 28 MICROORGANISMS ON pH REFRACTIVE INDICES COLOR TASTE AND ODOR OF TOMATO JUICE

ORGANISM	pH					REFRACTOMETER READING					COLOR	TASTE	ODOR
	1st Week	2nd Week	3rd Week	4th Week	5th Week	1st Week	2nd Week	3rd Week	4th Week	5th Week	5th Week	5th Week	5th Week
Control (not inoculated)	4.28	4.26	4.29	4.28	4.28	1.3412	1.3436	1.3429	1.3430	1.3411	Tomato	Normal	Normal
Alternaria sp. (1)*	4.24	4.10	3.83	4.76	6.41	1.3427	1.3414	1.3393	1.3356	1.3362	Black	Musty	Musty
Alternaria sp. (2)**	4.30	4.18	4.28	4.26	4.40	1.3429	1.3430	1.3443	1.3415	1.3372	Tomato	Normal	Normal
Aspergillus niger 1	4.04	4.94	5.00	6.74	6.55	1.3401	1.3353	1.3351	1.3345	1.3336	Dark Brown	Musty	Musty
Aspergillus niger 2	4.17	4.20	4.58	4.78	6.98	1.3416	1.3404	1.3398	1.3376	1.3361	Light Brown	Musty	Musty
Aspergillus herbariorum 1	4.13	4.23	7.36	7.86	9.08	1.3418	1.3720	1.3365	1.3341	1.3342	Dark Brown	Bitter	Pungent
Aspergillus herbariorum 2	4.30	4.22	4.22	4.26	4.37	1.3421	1.3422	1.3365	1.3378	1.3380	Tomato	Normal	Normal
Beauveria sp. 1	4.60	4.75	8.42	8.72	8.80	1.3383	1.3374	1.3358	1.3370	1.3362	Orange	Flat	Musty
Beauveria sp. 2	4.20	4.23	4.44	4.44	4.79	1.3401	1.3390	1.3396	1.3382	1.3380	Tomato	Flat	Musty
Cephalosporium sp. 1	4.15	8.01	8.87	9.04	9.11	1.3365	1.3327	1.3350	1.3348	1.3348	Brick Red	Flat	Flat
Cephalosporium sp. 2	4.21	4.23	4.42	4.88	5.39	1.3424	1.3413	1.3396	1.3367	1.3362	Brick Red	Flat	Flat
Choanephora sp. 1	4.13	8.87	9.06	8.96	8.99	1.3370	1.3359	1.3366	1.3352	1.3356	Brick Red	Bitter	Pungent
Choanephora sp 2	4.20	4.24	4.46	4.70	4.88	1.3421	1.3416	1.3393	1.3388	1.3384	Red	Bitter	Pungent
Colletotrichum sp. 1	4.27	8.90	9.09	8.98	9.44	1.3411	1.3377	1.3350	1.3366	1.3362	Brown Orange	Musty	Pungent
Colletotrichum sp. 2	4.21	4.82	4.98	5.20	5.86	1.3421	1.3418	1.3390	1.3392	1.3387	Orange	Musty	Normal
Debaromyces lactis sp. 1	4.06	4.28	7.80	8.36	8.90	1.3383	1.3370	1.3354	1.3356	1.3365	Brown	Bitter	Pungent
Debaromyces lactis sp. 2	4.17	4.21	4.18	4.24	5.23	1.3423	1.3420	1.3429	1.3396	1.3372	Tomato	Bitter	Normal
Diplosporium sp. 1	4.33	4.78	4.66	8.86	9.53	1.3415	1.3409	1.3430	1.3350	1.3357	Brown	Flat	Pungent
Diplosporium sp. 2	4.22	4.11	4.23	4.23	7.32	1.3443	1.3443	1.3448	1.3420	1.3380	Tomato	Bitter	Normal
Eurotium sp. 1	4.27	4.70	8.42	9.03	8.83	1.3403	1.3358	1.3354	1.3350	1.3363	Light Brown	Bitter	Pungent
Eurotium sp. 2	4.27	4.31	4.46	4.92	6.28	1.3422	1.3417	1.3366	1.3363	1.3382	Tomato	Bitter	Normal
Fusarium sp. 1	4.23	4.29	5.22	6.61	9.40	1.3402	1.3350	1.3364	1.3365	1.3363	Orange Brown	Flat	Pungent
Fusarium sp. 2	4.24	4.16	4.23	4.45	8.91	1.3423	1.3430	1.3418	1.3373	1.3380	Tomato	Sour	Sour

TABLE I—(*Continued*)

ORGANISM	pH					REFRACTOMETER READING					COLOR	TASTE	ODOR
	1st Week	2nd Week	3rd Week	4th Week	5th Week	1st Week	2nd Week	3rd Week	4th Week	5th Week	5th Week	5th Week	5th Week
Myrothecium sp.	4 27	4 21	4 27	6 12	7 06	1 3422	1 3418	1 3420	1 3364	1 3358	Tomato	Bitter	Sour
Myrothecium sp.	4 28	4 96	5 22	5 41	5 44	1 3423	1 3421	1 3412	1 3396	1 3372	Tomato	Bitter	Normal
Monilia sp. 1	4 37	5 40	8 92	9 15	9 56		1 3376	1 3374	1 3371	1 3373	Dark Brown	Flat	Pungent
Monilia sp. 2	4 26	4 37	4 67	4 73	5 62	1 3421	1 3404	1 3381	1 3381	1 3379	Tomato	Flat	Pungent
Mucor sp. 1	4 29	4 12	5 54	6 08	8 53	1 3382	1 3372	1 3364	1 3361	1 3370	Orange	Sour	Sour
Mucor sp. 2	4 28	4 37	4 94	5 61	6 97	1 3342	1 3396	1 3392	1 3384	1 3386	Tomato	Sour	Sour
Paecilomyces sp. 1	4 17	4 18	6 32	7 17	6 83	1 3382	1 3365	1 3361	1 3360	1 3370	Dark Brown	Musty	Musty
Paecilomyces sp. 2	4 24	4 21	4 43	4 97	5 02	1 3441	1 3403	1 3395	1 3387	1 3373	Dark Brown	Musty	Musty
Penicillium sp. 1	4 53	6 73	7 46	7 58	8 11	1 3386	1 3358	1 3370	1 3368	1 3379	Tomato	Flat	Off
Penicillium sp 2	4 23	4 67	4 98	5 75	6 02	1 3408	1 3398	1 3372	1 3379	1 3378	Bright Red	Flat	Off
Pichia sp 1	4 21	4 31	4 98	6 64	7 76	1 3387	1 3371	1 3365	1 3363	1 3370	Orange	Sour	Sour
Pichia sp. 2	4 18	4 20	4 55	5 76	7 31	1 3383	1 3390	1 3382	1 3380	1 3376	Orange	Sour	Sour
Rhinocladium sp 1	5 10	5 96	6 98	7 44	8 09	1 3392	1 3384	1 3360	1 3353	1 3361	Dark Red	Bitter	Off
Rhinocladium sp. 2	4 26	4 34	4 38	5 12	6 95	1 3398	1 3392	1 3385	1 3385	1 3371	Dark Red	Bitter	Off
Rhizopus nigricans 1	4 70	5 21	5 94	6 72	7 33	1 3398	1 3383	1 3377	1 3378	1 3367	Dark Brown	Sour	Sour
Rhizopus nigricans 2	4 30	4 29	4 36	4 3	4 92	1 3396	1 3402	1 3390	1 3387	1 3381	Light Brown	Sour	Sour
Saccharomyces nadsoni 1	4 93	5 21	5 78	7 25	7 63	1 3382	1 3374	1 3380	1 3370	1 3362	Tomato	Sour	Yeast
Saccharomyces nadsoni 2	4 26	4 22	4 91	5 83	7 94	1 3406	1 3396	1 3381	1 3387	1 3370	Tomato	Sour	Yeast
Schizosaccharomyces sp. 1	4 34	4 22	4 23	4 02	5 95	1 3426	1 3422	1 3430	1 3430	1 3419	Tomato	Sour	Yeasty
Schizosaccharomyces sp. 2	4 21	4 18	4 33	4 67	4 82	1 3421	1 3423	1 3428	1 3430	1 3420	Tomato	Sour	Yeasty
Schizosaccharomyces octosporus 1	4 30	4 33	4 31	4 33	4 96	1 3433	1 3419	1 3391	1 3378	1 3373	Light Tomato	Sour	Yeasty
Schizosaccharomyces octosporus 2	4 22	4 20	4 38	4 56	4 54	1 3421	1 3426	1 3433	1 3431	1 3428	Light Tomato	Sour	Yeasty
Scopulariopsis sp 1	4 25	7 85	9 02	9 04	9 48	1 3375	1 3370	1 3355	1 3357	1 3366	Dark Brown	Bitter	Musty
Scopulariopsis sp. 2	4 30	4 22	4 25	4 47	8 43	1 3440	1 3444	1 3430	1 3399	1 3382	Tomato	Normal	Normal

TABLE I—(*Continued*)

ORGANISM	pH					REFRACTOMETER READING					COLOR	TASTE	ODOR
	1st Week	2nd Week	3rd Week	4th Week	5th Week	1st Week	2nd Week	3rd Week	4th Week	5th Week	5th Week	5th Week	5th Week
Syncephalastrum cinereum 1	4 18	4 07	4 74	4 61	9 04	1 3412	1 3380	1 3389	1 3370	1 3354	Light Brown	Flat	Off
Syncephalastrum cinereum 2	4 16	4 13	4 24	4 27	4 31	1 3443	1 3435	1 3425	1 3450	1 3386	Tomato	Normal	Normal
Torula sp. 1	4 66	5 24	5 93	6 76	7 41	1 3393	1 3384	1 3375	1 3378	1 3372	Deep Red	Sour	Yeasty
Torula sp. 2	4 03	4 18	4 65	4 98	5 74	1 3407	1 3398	1 3399	1 3391	1 3386	Tomato	Sour	Yeasty
Trichoderma sp. 1	4 21	4 50	8 44	8 84	9 04	1 3460	1 3394	1 3364	1 3380	1 3344	Dark Brown	Flat	Off
Trichoderma sp. 2	4 33	4 24	4 42	7 32	7 09	1 3452	1 3432	1 3409	1 3380	1 3368	Dark Brown	Slight Sour	Sour
Verticillium sp. 1	5 06	5 45	7 32	8 44	9 60	1 3379	1 3381	1 3366	1 3373	1 3366	Dark Brown	Sour	Musty
Verticillium sp. 2	4 17	4 28	4 56	5 32	5 95	1 3424	1 3413	1 3398	1 3382	1 3385	Brown	Sour	Musty
Hansenula sp. 1	5 03	5 42	5 87	6 12	6 99	1 3426	1 3389	1 3372	1 3362	1 3360	Lt Tomato	Sour	Yeasty
Hansenula sp. 2	4 19	4 68	4 97	5 62	5 73	1 3442	1 3438	1 3410	1 3391	1 3389	Tomato	Sour	Yeasty

*100 ml juice in 250 ml. flask

**100 ml juice in 125 ml flask (reduced oxygen content)

In the 250 ml flasks an increase in pH was accompanied by a decrease in the refractometer readings indicating a decrease in total solids content Those organisms producing the most pronounced pH changes included *Aspergillus herbariorum, Choanephora* sp , *Colletotrichum* sp , *Diplosporium* sp , *Fusarium* sp , *Scopulariopus* sp , *Trichoderma* sp , *Verticillium* sp , *Cephalosporium* sp and *Monilia* sp The pH of these organisms at the end of the fifth week was over nine The organisms giving the greatest decrease in refractometer readings were *Aspergillus niger, Aspergillus herbarorium, Cephalosporium* sp and *Syncephalastrum cinereum*

As incubation progressed color changes became more marked The fungi at the end of the fifth week produced colors ranging from an orange to a brick red to a dark brown Most of the yeasts produced an orange white color A change in color was accompanied with the production of off tastes and odors At the end of the first week no off odors or flavors were detected in the flasks containing fungi (Table I)

Data on each organism was recorded as given in Table II This table shows the early change in color, taste and odor produced by *Aspergillus niger*

TABLE II

THE EFFECT OF *Aspergillus niger* ON pH REFRACTIVE INDICES, COLOR, TASTE AND ODOR

Organism	No of Weeks	pH	Refractometer Reading	Color	Taste	Odor
Aspergillus niger	1	4 04	1 3401	Normal	Normal	Normal
	2	4 94	1 3352	Dark Brown	Musty	Musty
	3	5 60	1 3351	“ “	“	“
	4	6 74	1 3345	“ “	“	“
	5	6 55	1 3336	“ “	“	“
Reduced oxygen content	1	4 17	1 3416	Normal	Normal	Normal
	2	4 20	1 3404	“	“	“
	3	4 58	1 3398	“	“	“
	4	4 78	1 3376	“	“	“
	5	6 98	1 3361	Light brown	Musty	Musty

CONCLUSIONS

1 pH values increased progressively with the length of incubation

2 As the pH values resulting from mold growth increased, the refractive indices decreased

3 Color changes occurred after the first week ranging from orange to brick red to dark brown

4 In most samples of moldy product off flavors and odors were produced between the second and third week Yeast produced sour flavors and yeasty odors within the first week of incubation

5 Since the development of molds depends in part upon an adequate supply of oxygen, it is obvious that commercial canners need not be concerned about the development of off flavors from these organisms after the product is effectively canned or bottled On the other hand, it is possible that off flavors can be developed from molds growing on tomato fruits or the crushed product prior to the sterilization and inclosure in receptacles which greatly limit the supply of oxygen This contamination can occur in the farmers' fields, at the cannery yard, receiving station, on conveyor belts, pumps and other plant equipment

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NEW COLEOPTERA WITH NOTES

(ELATERIDAE, BUPRESTIDAE AND CERAMBYCIDAE)

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Department of Zoology and Entomology,
The Ohio State University

Lacon floridanus n sp

Female —Form robust, elongate, resembling *L obtecta* (Say) in outline. Ground color dark brown, surface clothed with rather broad, pointed, elongate, gray scales which are broader above than beneath

Head broadly concave on front surface closely, coarsely punctured, eyes small, antennae extending to little beyond middle of pronotum when laid along side, scape stout, second segment wider than long third slightly shorter than scape, following segments gradually decreasing in length, third to tenth inclusive serrate, eleventh oval, as long as third, scape and second segment with much longer pubescence

Pronotum slightly longer than wide widest at middle, much wider at base than at apex, sides broadly rounded in front, sinuate near hind angles which are strongly divergent, disk convex, flattened transversely at apex strongly depressed each side at base forming raised area in front of scutellum, hind angles carinate, surface densely, coarsely punctured, leaving narrow smooth area extending some distance in middle. *Scutellum* elongate obtusely rounded in rear

Elytra at base as wide as base of pronotum, sides subparallel near base converging to apical fifth, then broadly rounded to suture, disk convex, basal depressions deep surface with rows of coarse punctures, narrower than interspaces near suture becoming larger than interspaces laterally, interspaces with fine punctures near suture, larger laterally

Prosternum densely, coarsely punctured, antennal grooves diverging anteriorly, extending nearly to coxal cavities, tarsal grooves lacking Abdomen beneath finely punctured in middle, punctures becoming larger laterally last visible sternite obtusely rounded densely punctured over entire surface Legs slender

Length 19 5 mm., width 6 1 mm

Holotype ♀ collected at Coral Gables Fla , May, 1948, by H F Strohecker in collection of author

Lacon mexicanus (Cand)

Adelocera mexicana Candèze, 1857, Mém Soc Liège, 12 70, Champion, 1894, Biol Centr Amer , Col , 3.259 260 pl 11, fig 1

Adelocera nobilis Fall, 1932, Can Ent , 64 58

Adelocera mexicana, Van D , 1932, Proc Cal Acad Sci , 20 293

Adelocera nobilis and *mexicana*, Fall, 1934, Jour N Y Ent Soc , 42 7

Adelocera mexicana, Van D , 1943, Pan Pacific Ent , 19 44.

A ♂ specimen collected in Ross Hammock, Dade Co Fla , by H F Strohecker and a ♀ labeled Florida, Wenzel Collection, agree very well with a ♀ taken in Santa Rita Mts , Ariz., July 13, by D J & J N Knull

Pyrophorus havaniensis (Cast)

Figs. 2 and 3

Stilpnus havaniensis Castelnau, 1840 Hist Nat Ins , Col 1:236, Jacq du Val 1857, Sagra's Hist Cuba, 7 73, pl 7, figs. 14–18, Candèze 1863, Mém. Soc Sc Liège, 17:29, Champion, 1896, Biol Centr Amer , Col , 3 469, pl 20, fig 26

Pyrophorus causticus Germar, 1841 Zeitschr Ent , 3.36

Pyrophorus impressifrons Strum 1843, Cat Ins. Sammlung Käf , p 67

Specimens[1] of this Cuban species labeled Miami May 10 1948 and Dade Co , Florida, May 24 and June, 1948, were collected by H F Strohecker

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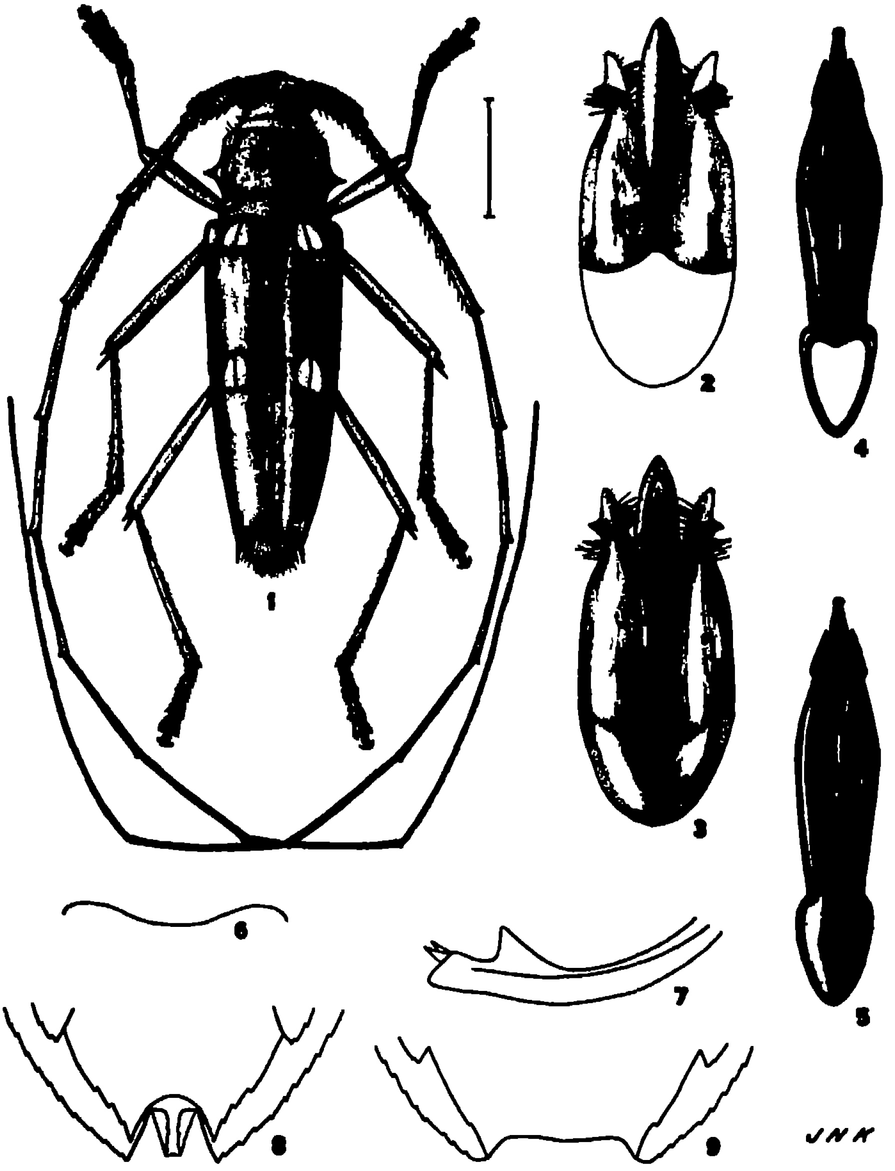
[1] Determination verified by R H Arnett through C F W Muesebeck



1 *Eburia stroheckeri* n sp ♂ (Line equals 5 mm) 2 *Pyrophorus havaniensis* Cast ♂ genitalia, dorsal view 3 Ventral view of number 2

Chrysobothris distincta Gory 4 ♂ genitalia dorsal view 5 Ventral view of number 4 6 Clypeal margin 7 Anterior tibia of ♂ 8 Last visible sternite of ♀ 9 Last visible sternite of ♂

It differs from the other four species recorded from the United States by Hyslop[2] by elongate cuneate elytra, which are divaricately spinose at apices

Chrysobothris distincta Gory[3]

Figs 4, 5, 6, 7, 8 and 9

1841, Monogr Bupr Sup, 4 176, pl 30 fig 1171, Waterhouse, 1887, Biol Centr Amer Col 3, pt 1, 45, Gemminger & Harold, 1869, Cat Col, 5 1425, E Saunders, 1871, Cat Bupr, 97, Kerremans 1892 Mém Soc Ent Belg 1 212 Wystman, 1903, Genera Ins, fasc 12, 186, Obenberger 1940, Sborn ent Praze, 18·93

Two ♂ specimens labeled "Cal" were in the Andrew Bolter collection, now at Illinois State Natural History Survey A ♀ in collection of author with same label indicates that it should be included in our fauna as stated by Obenberger

It runs to *C peninsularis* Schffr in Fisher's key[4] but can be separated by its more elongate form structure of male genitalia and deeper indentation of last visible sternite of ♀

Eburia stroheckeri n sp

Fig 1

Male —Form elongate, resembling *distincta* Hald Above and beneath light reddish brown, abdomen darker, legs light yellow, tarsi and apices of tibiae brown Each elytron with two oval contiguous, eburneous spots at base and at middle Densely clothed above and below with very short recumbent pubescence, lacking around elytral spots

Head deeply transversely grooved back of clypeus longitudinally grooved between elevated antennal tubercles, surface rugose, eyes separated above by more than diameter of upper lobe, antennae extending over five segments beyond apices of elytra, scape robust, concave near base, three following segments stouter than outer ones second about as long as broad, following segments gradually increasing in length, eleventh nearly as long as entire body, segments three to ten inclusive with blunt spines on outside at apices scape rugose, scabrous, four following segments scabrous, third and following segments flattened carinate on outside pubescence corresponding to body, longer hairs beneath on first five segments

Pronotum wider than long, wider at base than at apex basal margin sinuate, side margin irregular with large acute brown spine in middle an obtuse tubercle between spine and front margin, disk convex with transverse depression back of apex and a like sinuate area near base, an obtuse brown spine in front of middle on each side, surface rugose *Scutellum* wider than long, rounded in rear

Elytra at base wider than base of pronotum, widest at base, sides converging to apical fifth, then broadly arcuate to bispinose apices, outer spine much longer than sutural spine, disk convex, humeral depressions deep, eburneous spots raised, surface minutely punctate, punctures concealed by vestiture, larger and more evident on denuded areas around spots

Body beneath minutely punctate punctures concealed by vestiture, with few erect longer hairs Legs slender, middle and posterior femora bispinose at apices, inner spine much longer

Length 21 3 mm width 6 mm

Female —Differs from ♂ by being more robust with shorter antennae, extending beyond apices of elytra a little over three segments

Holotype ♂ and allotype collected in coitu in Matheson Hammock, Dade Co, Florida, June 4, 1948, by H F Strohecker Type material in collection of author

This species is close to *E jamaicae* Fishr[5] but both male and female antennae are carinate and spinose Elytra spots lack dark areas too It is distinguished from *E distincta* Hald which it resembles, by having longer, spinose antennae in both sexes.

The writer is indebted to Dr Strohecker for specimens mentioned in this paper

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[2] J A Hyslop Proc Ent Soc Wash 19 1-12, 1917

[3] Determined by W S Fisher

[4] W S Fisher, Misc Publ 470 U S D A, 1-275, 1942

[5] W S Fisher, Torreia, 10 6, 1942

THE LABORATORY CULTIVATION AND DEVELOPMENT OF THE MYXOMYCETES PHYSARELLA OBLONGA AND PHYSARUM DIDERMOIDES[1]

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The literature revelant to the cultivation of myxomycete plasmodia on artificial media reveals only one record of the cultivation of *Physarella oblonga* (Berk & Curt) Morgan and but two records of the laboratory cultivation of *Physarum didermoides* (Ach) Rost Gilbert (1931) stated that in a few instances sporangia of the first species had been obtained by placing spores on slightly acidified corn meal agar, aside from this one statement the writer has found no other references concerning the culture *P oblonga* although the species has received some cytological and morphological study Bisby (1914) described capillitium development, and the gross details of sporangium development of this species were described and figured by Emoto (1934), both Bisby's and Emoto s observations however were made on naturally occurring material Constantineanu (1906), in an extensive paper on the development of Myxomycetes, described the cultivation of *P didermoides* on various types of media but included no figures and made no statement concerning maintenance of the species in culture by means of plasmodial transplants Kambly (1939) stated that he was able to obtain plasmodia of *P didermoides* on carrot decoction agar but that on this medium the plasmodia did not flourish and never completed their life cycles The writer has had considerable success with the culture of both species and finds them well-suited for the demonstration of sporangial development as well as the illustration of pigmented and non-pigmented plasmodial types Both are slow-growing when compared with such a species as *Physarum polycephalum* Schw , but they grow rapidly enough that after twelve or fourteen days inocula for thirty or forty cultures may be obtained from a single petri plate culture

MATERIALS AND METHODS

Two types of media have been employed in these studies (1) corn decoction agar, prepared by grinding 25-50 gms of field corn adding 500 ml of distilled water, autoclaving for one hour at fifteen pounds pressure, filtering, adding enough distilled water to bring the total volume to one liter, adjusting to pH 5 2-5 4, adding 15 gms of agar and sterilizing, (2) corn decoction agar, as prepared above, with 25 gms of filter paper (finely divided by triturating wet in a mortar) suspended in each liter Both species grew quite well on both types of media, because of the greater ease of preparation, plain corn decoction agar was used in most of the work

Smith (1929) has shown that spores of various species of Myxomycetes remain viable for many years, but so far the writer has had consistently better results with spores not over two or three years old Unsterilized medium may be used, but, because these plasmodia grow slowly, it is best to use sterile medium in order to hold contamination to a minimum, although even with sterile medium the cultures are never completely free of other organisms

CULTIVATION OF PHYSARELLA OBLONGA

Spores from a two months old collection of this species, when placed in a drop of distilled water in a corn decoction agar slant, germinated and in fifteen days or less small yellow plasmodia were visible Some variation in the time required for plasmodium formation is to be expected, since age, vitality of the spores, and other factors undoubtedly influence both spore germination and plasmodium growth After plasmodia had appeared in the test tubes they were maintained in the vegetative stage by transferring small blocks of agar, on which there were bits of plasmodia, to fresh medium in 75 mm petri dishes Subsequent transfers were made in the same manner If cultures are stored in the dark, subcultures need not be made at lesser intervals than three weeks By such methods the species was maintained in culture continuously for nine months, Fig 2 shows a nine day old culture of *P oblonga*, Fig 5 shows a bit of plasmodium enlarged four diameters

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[1] Paper from the Department of Botany and Plant Pathology, The Ohio State University, Columbus 10 Ohio No 509

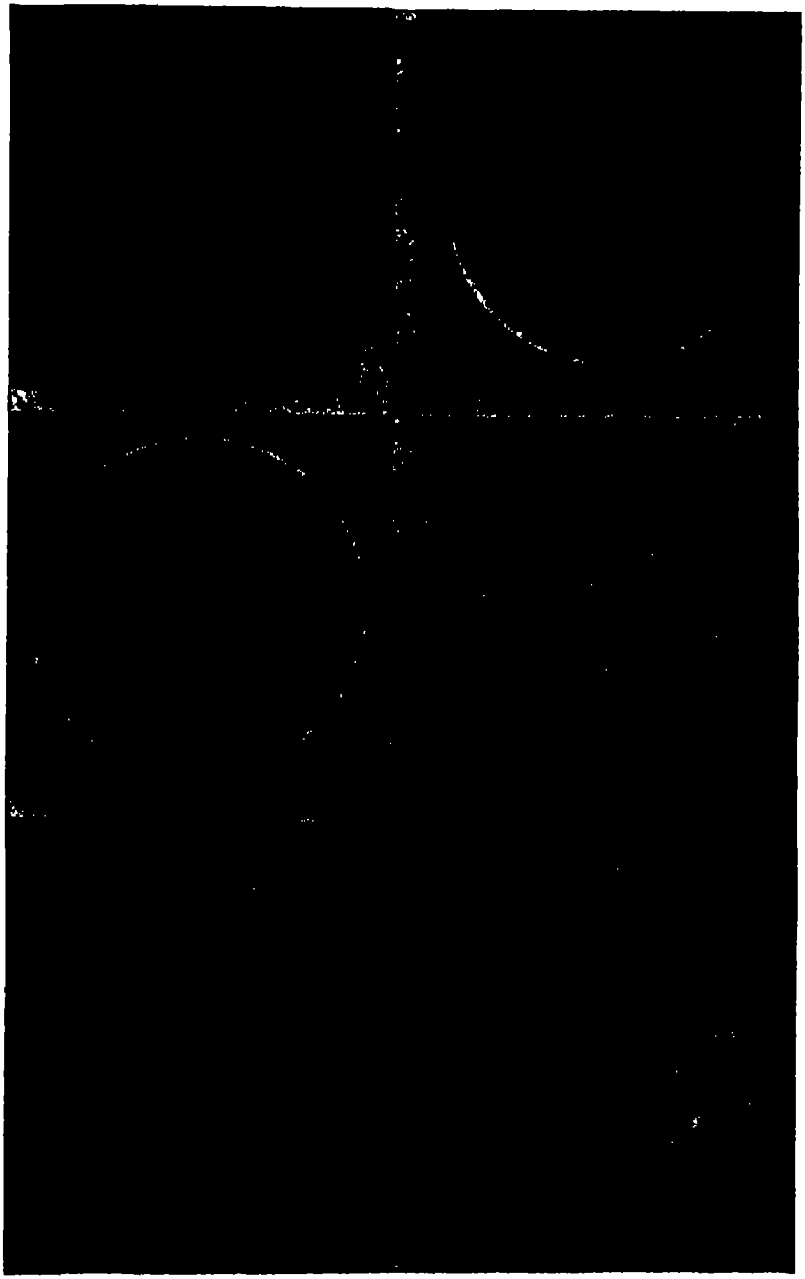
In order to determine if light has any effect upon fruiting, cultures were placed both in light and darkness Of fifty cultures placed in the dark, fruiting bodies were formed in but two, and, of course, all of these cultures were exposed to light for short periods, since they were examined daily, sporangia appeared in forty out of sixty cultures which were placed in the light Thus, light affects this species in the same way as previously reported for other species with yellow plasmodia (Gray, 1938) Under laboratory conditions, if plasmodia are left undisturbed, fruiting bodies formed in 15–18 days, while if they are covered with black cloth or placed in a drawer, plasmodia may remain in the active vegetative state for periods as long as seventy days provided the agar substrate does not become dry

The time required for the development of sporangia from plasmodium is 11–12 hours, once sporangial formation has started Fruiting is manifested when enlargements appear in the larger strands of the plasmodium (Fig 6), protoplasm flows into these enlargements and they become still larger with the final result that the strands of plasmodium connecting them disappear Shortly after this, an umbilicus appears in the top of each globule of protoplasm (Fig 7) and soon definite stipes are formed The stipes gradually elongate, and just before maximum length is attained, the stipe bends just below the developing sporangium, and thus the sporangia are typically nodding although in some instances they may be borne upright Sporangia retain the same yellow color as the plasmodium until final form is attained, and then they gradually darken, however, as soon as the stipes become apparent, they gradually darken from the basal portion upward Emoto (1934) has figured the various stages in the development of sporangia of this species, all such stages are not shown here

Both plasmodiocarpous and sporangial types of fruiting bodies are formed by *P oblonga* in its natural habitats, however, plasmodiocarps have appeared in only a few cultures It has been found that sporangia are more like naturally occurring fruitings when they are formed under drier conditions, therefore, when the fruiting process is once initiated, it is advisable to remove the petri dish covers Atypical sporangia and plasmodiocarps are generally formed when the plasmodial enlargements are irregularly shaped (Figs 9 and 10) The type of formation in Fig 8 may give rise to a typical sporangium but more frequently develops into a fruiting body with a saddle-shaped sporangium which is suggestive of a minute *Helvella*

EXPLANATION OF PLATE I

FIG 1 Nine day old culture of *P didermoides* × ⅗ FIG 2 Nine day old culture of *P oblonga* × ⅗ FIG 3 Early stage in the fruiting process of *P didermoides*, shortly after sporangia have been delimited × ⅗ FIG 4 Enlarged portion of plasmodium of *P didermoides* × 4 FIG 5 Enlarged portion of plasmodium of *P oblonga* × 4 FIG 6 Enlargement in plasmodium of *P oblonga* which is indicative of initiation of the fruiting process × 10 FIG 7 Typical umbilicate immature sporangium of *P oblonga* × 10 FIGS 8, 9 10 Plasmodial enlargements which give rise to atypical sporangia × 10 FIG 11 Mature sporangia of *P didermoides* × 4



ascocarp Spores from fruiting bodies developed in culture are viable and will germinate and produce swarm cells and plasmodia when placed upon fresh medium, however, no viable sclerotia have been obtained thus far

CULTIVATION OF PHYSARUM DIDERMOIDES

White plasmodia of this species were obtained by the same method as that employed for the preceding species Plasmodia were obtained in about fifteen days after spores from a five months' old culture were sown Of the various non-pigmented plasmodia that have been cultured by the writer, this form is probably the most suitable for laboratory cultivation The plasmodia are quite tolerant of mechanical injury, and hence subcultures may be made employing very small amounts of plasmodium Sporangia are formed in either light or darkness, the average time of fruiting for forty cultures being twenty-one days after the cultures were made In order to maintain the species in its vegetative state, subcultures should be made every 18–20 days In this manner, *P didermoides* has been maintained in culture continuously for over six months Once a culture is established, little care need be observed so far as the maintenance of sterile conditions is concerned, since this species is strongly mycophagous and bacteriophagous, and contaminants are rarely able to become established Plasmodia of this species are shown in Figs 1 and 4

The fruiting process in this species requires 8–10 hours from initiation to completion and differs somewhat from this process as seen in *P oblonga*, this should be expected since sporangia of *P oblonga* are not crowded together as in *P didermoides* In the latter species instead of the appearance of enlargements in the plasmodial strands, initiation of the fruiting process is manifested when all of the protoplasm of the plasmodium flows into a solid lump A few hours after this, pearly-white, discrete sporangia may be observed (Fig 3) After the fruiting bodies have attained their final shape and size they become light, brownish-lavender in color, from this they gradually change until the blue-gray color of mature sporangia is attained In most fruitings the white hypothallus typical of the species is present Mature sporangia are shown in Fig 11 In a few cultures plasmodia became pale lavender three or four days before fruiting bodies were formed, but in most cultures there was no color change until after sporangial delimitation was apparent

Viable sclerotia of *P didermoides* were obtained by removing the covers from petri dish cultures of actively growing plasmodia and allowing the plasmodia and agar substrate to dry slowly Upon being moistened such sclerotia revived and streaming could be observed in about twenty-four hours As in the preceding species, spores from sporangia which developed in culture were found to be viable

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THE ROLE OF THE SUBEPIDERMAL NERVOUS SYSTEM IN THE LOCOMOTION OF THE EARTHWORM

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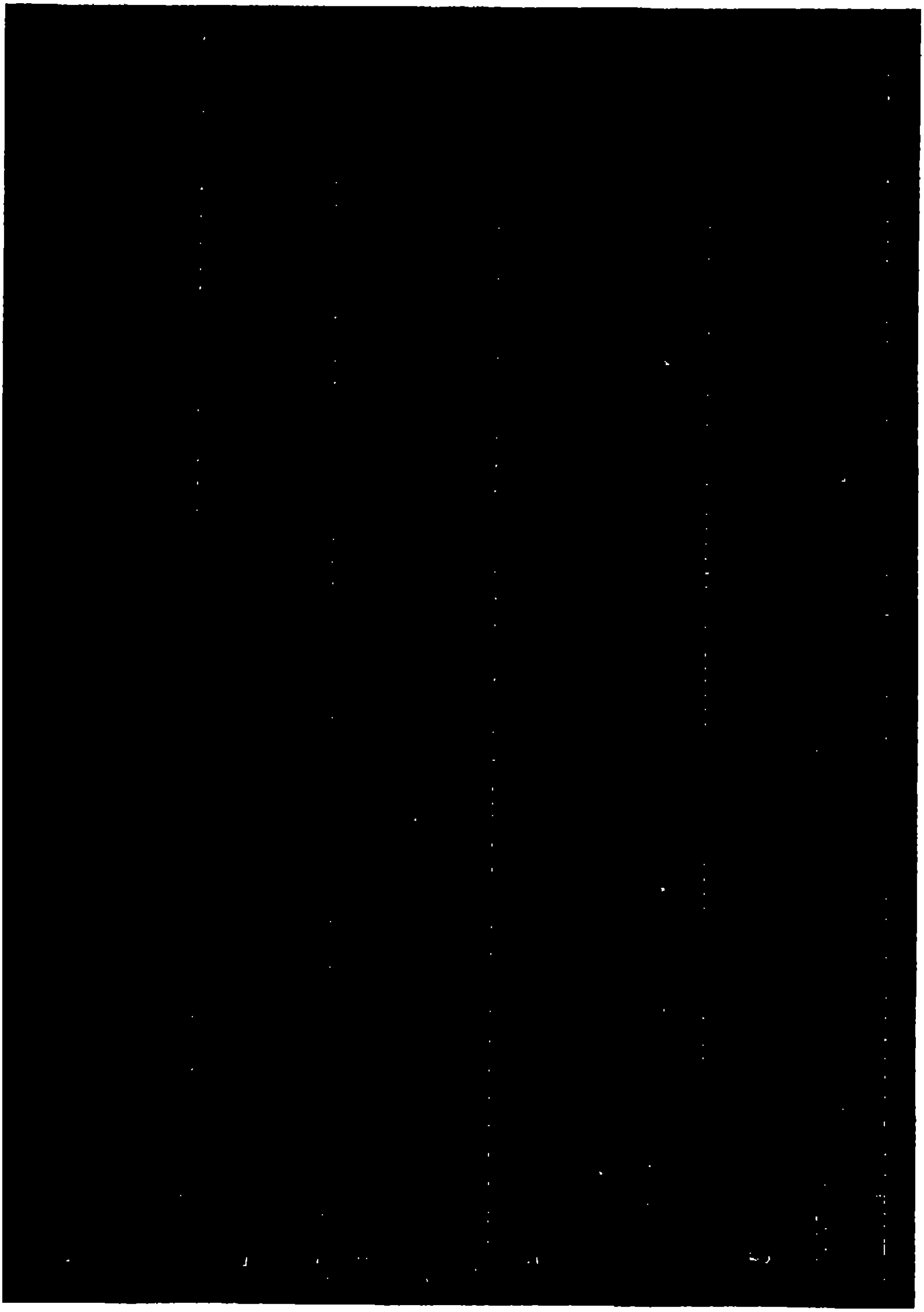
Friedländer (1894) was the first one to show that the central nervous system plays only a small part in the creeping movement of an earthworm He concluded that the wave-like motion of the contractions proceeding the length of the worm was due first to the "pull" of segments on each other, and secondly to the sequence of reflex actions in each segment This nervous mechanism according to Friedländer, involves the individual segment alone without the passage of impulses through the cord Biedermann ('04) found that when the middle region of a worm was anaesthetized, the posterior region acted in perfect coordination with the anterior part in creeping movements In another experiment he observed that when the anaesthetized region was pinned to a cork plate, the posterior part still moved in perfect coordination with the anterior part Thus, he demonstrated the transmission of impulses over considerable distance in the cord Garry and Moore ('15) studied the coordination of the peristaltic waves They verified the work of Biedermann to the extent that the peristaltic impulses are conducted by the cord Straub (1900) observed that strips of body wall both with and without ventral nerve cord will give rhythmic contractions However, the strips removed from denervated regions required several (eight) days for recuperation before such strips could produce rhythmic contractions Budington ('02) found that when care was used to remove all nervous tissue and used only pieces of worm in which the whole ventral muscle had been removed they failed to demonstrate rhythmic contraction An extensive study of the transmission of the nervous impulses in relation to locomotion was made by Bovard ('18) He showed that after the cord was cut at the middle region of the body, both ends would not act in perfect coordination He disagreed with Straub's (1900) finding that a piece of the body wall without nerve cord is able to make rhythmic contraction

On the other hand the presence of a subepidermal network of nerves was observed by Retzius (1892), Smirnow (1894), Langdon (1895), and Smallwood ('23, '26) and was carefully studied morphologically by Hess ('25) Hess found that the subepidermal network of nerves in the earthworm is a true nerve plexus composed of anastomosing nerve fibers which form a network in the region between the bases of the epidermal cells and the basement membrane He concluded that this plexus is not segmental in its arrangement Coonfield ('32) disagrees with Hess and Smallwood regarding the continuous nature of the plexus His experiments on the secretion of mucous and the discharge of coelomic fluid show that impulses are not transmitted from somite to somite without the presence of the ventral nerve cord He concluded that the peripherial nervous system is not a continuous nerve net

Because of these controversies of opinions, it is the purpose of this paper to present the results obtained from further investigations employing physiological methods The earthworm used in the following experiments is *Lumbricus terrestris*, found in Columbus, Ohio The room temperature during the experiments was 26–27° C

BEHAVIOR FOLLOWING REMOVAL OF VENTRAL NERVE CORD

Sections consisting of 40–60 segments exclusive of the head were cut from healthy unanaesthetized worms Following the removal of the intestine in saline



solution, the body wall was turned inside out and the ventral nerve cord was completely removed with the aid of the binocular microscope The body wall was then reversed (skin side out) and placed in a Petri dish containing normal saline Solution It was seen under the binocular microscope that this operated section exhibited only slight constriction movements When these movements were watched carefully, we could see that each was confined to an individual segment and was independent of the remaining segments After one to two hours, the above described involuntary movements ceased to occur The section as a whole, however, was more sensitive to touch If such a section was touched or pinched, a wave of longitudional muscle contraction could be initiated at any segment and could move in either or both directions The sequence of contraction was segment to segment Measuring with a stop watch, it was determined that the rate of contraction wave varied from 3 0 segments per second to 4 3 segments per second. The average rate was 3 8 segments per second The distance traveled by the contraction wave in the pieces tested varied from 11–43 segments Stimulation of a section in the middle would initiate waves of contraction in both directions The speed of the contractions thus initiated was the same in both directions The contraction of the circular muscle was not observed when the body wall was pinched or touched

Each operated section was then attached to a recording lever The section was so placed that it hung vertically with only very slight stretching by the lever The whole piece was kept submerged in normal saline solution and the contractions were recorded in a slowly moving kymograph drum It was found that of the many pieces tested, some of them recorded autonomic contractions during the first few hours after their preparation (see figure 1) Those sections which did not give immediate contractions were kept in refrigeration at 5°C for a day and then were allowed to stay at room temperature for a few hours before they were tested again It is shown in the kymograph record (see figure 3) that active autonomous contractions of shorter intervals were initiated by such treatments

However, both the magnitude and rhythm of contractions of a single piece or of the different pieces varied a great deal It was observed that the magnitude of the contractions depends in part upon the total length of the section and the vitality of the piece tested It is also related to the distance of the contraction waves traveled, i e , the farther the waves travel, the greater will be the magnitude, because of the fact that the relaxation phase is much shorter than the contraction phase as the contraction waves travel along each of the successive somites As to the rhythm, the intervals of contraction were irregular, varying from two to five minutes

In order to determine whether the magnitude or the interval of contractions in a given section could be changed by splitting, a previously tested section was split longitudinally along the middorsal line It was observed that immediately after splitting, the length of the section became much shorter A section thus

EXPLANATION OF PLATE I

FIGURE 1 The rhythm of contractions of a section (42 segments) whose nerve cord has been completely removed

FIGURE 2 The decrease of frequency and magnitude of contractions following a longitudinal split along the middorsal line (The same section used in the illustration Figure 1)

FIGURE 3 Showing the occurrence of contractions of a section (40 segments) which has been kept in refrigeration for a day

FIGURE 4. Illustrating the coordinated movement of the tail after each extension of the head when ten segments of the middle region of the body were fixed by pinning Each peak represents maximum contraction

FIGURE 5 Demonstrating that no coordinated movement of the tail took place when the nerve cord was cut in the fixed region

operated lengthened in time but never regained its initial length The magnitude of contractions of such operated pieces diminished while the interval of contractions increased (see figure 2) This is interpreted as the result of the loss of tone of the circular muscle layer

DISTANCE OF IMPULSE TRANSMISSION THROUGH THE SUBEPIDERMAL NERVOUS SYSTEM

An unanaesthetized worm was split longitudinally along the middorsal line for a distance of ten segments in the midbody region The intestine was removed from this region exposing the ventral nerve cord The operated portion was then fixed firmly in a dissecting tray with small-sized insect pins (about three to four pins on each segment) The pinning process was done under the dissecting microscope to avoid injury to the segmental nerves Both the anterior and posterior regions were free to move Only the posterior tip was connected to the recording lever The initiation of each extension of the head was marked by a signal magnet The record (figure 4) shows that the impulses from the head region could be transmitted through the fixed middle region to the tail in an average of four seconds when the ventral nerve cord was intact When the nerve cord was severed between the seventh and eighth segment of the fixed operated region without injury to the lateral nerves, there was no movement of the tail following head extension in this experiment (figure 5) It was necessary that the nerve cord be cut near the caudal margin of the exposed area in order that all "pull" produced by the unattached anterior region would be eliminated Furthermore movement of the tail region could not be induced by applying Faradic shocks to the cord in the head region This clearly shows that the subepidermal nervous system cannot transmit locomotor impulses from one segment to the next if the segments are prevented from movement The experimental evidence further substantiates the contention that the subepidermal nervous system is segmental in arrangement

DISCUSSION

The occurrence of irregular contractions of a section lacking the ventral nerve cord is worthy of discussion These experiments have been repeated several times and consistant results obtained It is also necessary to mention here that extreme care was taken to eliminate the entire ventral nerve cord It has been shown that when the body wall was split longitudinally, the tone of the circular muscle layer was diminished, and the whole piece became shorter in length As a result both the frequency and magnitude of contractions decreased That Budington ('02) and Bovard's ('18) isolated strips could not produce contraction might be due to the loss of tone of the circular and longitudinal muscles In addition, sufficient time for recovery from operative shock or injury due to overstretching was necessary At all times the section should be kept in a saline solution bath even though attached to the recording lever In addition to the above requirements, the writers have found that a slight stretching of the section by the recording lever may be an important factor in initiating contraction Such contraction waves were not observed when the section was laid unattached in normal saline solution Zyeng ('30) has found that there are nerve cells located between longitudinal and circular muscles, between the epidermis and the circular muscle layer and sometimes within the circular muscle layer itself The presence of these cell bodies may account for the autonomic movement of the isolated piece in the absence of the ventral nerve cord

Bovard ('18) in interpreting the rhythmic contractions described by Straub suggested that such phenomenon may be due to the regeneration of nerve fibers and cells However, according to our observations, such contractions occurred either shortly after the operation or within twenty-four hours after recovery under refrigeration This strongly suggests that regeneration is not a factor in explaining this phenomenon

The results obtained by the writers using completely different physiological methods from those previously employed are in agreement with Coonfield's ('32) findings concerning the segmental arrangement of the subepidermal nervous system in the earthworm The impulses which are transmitted from segment to segment are not through the "subepidermal nerve net" but are conveyed through the peripheral nerves and ventral nerve cord In locomotion, impulses are initiated in successive segments by the pulling action of the adjacent segments

According to the writers' observations, the most probable functions of the subepidermal nervous system are the regulation of the contraction of the longitudinal muscle and as a reinforcement of locomotor impulses Bovard ('18) found that the locomotor impulses travel short distances of ten segments very readily, and more difficultly as the number of segments increases, but, impulses are unable to pass through a distance of thirty segments unless there is reinforcement from the muscle Let us make some mathematical calculations based on Bovard's and the writers' data to see whether our conclusion concerning the function of the subepidermal nervous system as a reinforcing mechanism can fit the actual situation The rate of the peristaltic waves of the earthworm under the conditions tested was found by the writers to be about 3 cm per second If a worm is 14 cm long, it will take 4 7 seconds for a contraction wave to travel from the head to the tail The time consumed in this reaction far exceeds the time required for actual impulse transmission But if we assume that in every ten segments a reinforcement takes place, then there will be fourteen reinforcements As found in one of the previous experiments, the rate of contraction wave in the body wall in absence of the nerve cord is approximately 3 8 segments per second (1 segment per 0 26 second) For fourteen reinforcements, it will take about 3 6 seconds which is ¾ of the total time needed for the propagation of the wave, and only 1 1 second is left for the transmission of the impulses through the nerve cord and the delay in the various synapses The synapses involved include those in the ventral nerve cord and those between the segmental nerve endings and the subepidermal neurons It seems that this shorter time fits better the faster conduction rate of the nerve impulses occurring in the central nervous system

The activity of the isolated section from which the ventral nerve cord was removed shows that the circular and longitudinal muscles are governed by two different sets of nerves Stimulation of the epidermis results in the contraction of only the longitudinal muscle The contraction of the circular muscle should therefore be controlled by the central nervous system This interpretation seems to fit very well with the mechanism of locomotion As we know, when a worm begins to move forward, the circular muscle of the head region contracts first The initiation of the contraction of the circular muscle is due to impulses from the central nervous system The contraction of the circular muscle in turn stretches the longitudinal muscle As a result, reinforcing impulses are sent into the central nervous system, and at the same time, a contraction of the longitudinal muscle is initiated

SUMMARY

1 In the absence of the ventral nerve cord, impulses can be initiated in the body wall and transmitted in both directions

2 The initiation of such impulses can be accomplished by mechanical stimulation

3 The impulses initiated in such a denervated section are conducted within the limits of a single segment through the subepidermal nerve net Such impulses originate in successive segments as a result of the pulling action of the adjacent segments

4 The contraction wave is 3 8 segments per second of a section without a ventral nerve cord

5 The subepidermal nervous system of the earthworm is shown through physiological analyses to be segmental in arrangement

6 The most probable role of the subepidermal nervous system is that of controlling the contraction of the longitudinal muscle and acting as a reinforcing agent in the peristaltic waves

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NEW EASTERN SPECIES AND A NEWLY REPORTED INTRODUCTION OF TYPHLOCYBA (HOMOPTERA, CICADELLIDAE)

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AND
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During the procedure of identification of material in the genus *Typhlocyba* in the course of preparation of the second part of the "Leafhoppers of Illinois," a few interesting new species have been encountered which are described in this paper To aid in comparison, illustrations of two other species are added

The species of *Typhlocyba* have previously been grouped by McAtee[1] on the basis of differences in wing venation The variation of the venation in individuals is sufficient, however, to frequently warrant the placing of individuals of the same species in different groups as defined by McAtee It would appear that it will be necessary eventually to group the species of the genus on the basis of male genital characters rather than upon the basis of wing venation No attempt has been made, therefore, in describing these species to place them in the groups established on the basis of wing venation

We wish to thank Dr R H Beamer for his opinions concerning certain of the species, and Dr P W Oman who has very kindly compared material and drawings of *eurydice* with McAtee's type which is now in the U S National Museum

In the interests of clearer description it has seemed advisable to introduce an additional term with regard to the aedeagus, a term which will be found useful throughout the Cicadellinae The aedeagus is divided into three fairly distinct parts, the base (*socle* of Ribaut), which is the part actually set in the membrane which connects the aedeagus to surrounding body members, a freely projecting portion usually termed the "free part of the aedeagus ' or some equivalent phrase, and for this part we propose the term *phalicata*, and various style-like processes arising from the base itself or from the area where the phalicata joins the base These latter processes have been called ventral processes, appendages of the aedeagus, and other phrases, for these it seems very convenient to use the term processes, which can be modified by various adjectives to indicate numbers and positions

Unless otherwise specified, types described in this paper are in the collection of the Illinois Natural History Survey

Typhlocyba tortosa new species

This species appears most closely related to *cassiopeia* Knull, but differs from it radically in the shape of the pygofer and the shape of the phalicata, which in *cassiopeia* has a pair of very long lateral processes and a large mesal lobe, but in *tortosa* fig 1, has the apex divided into a pair of quite short lateral processes with no appreciable mesal lobe Length male 3 mm

Color, white without markings.

Male pygofer broad at apex with a slight indication of a spine on the dorsal caudal margin. The aedeagus in lateral view has a phalicata which is gradually tapered to a slender attenuated apex In ventro-caudal view the phalicata is elongate, rather uniform in width to the apical portion which is divided on the apical fourth, forming a pair of somewhat divergent, tapered, pointed apical processes

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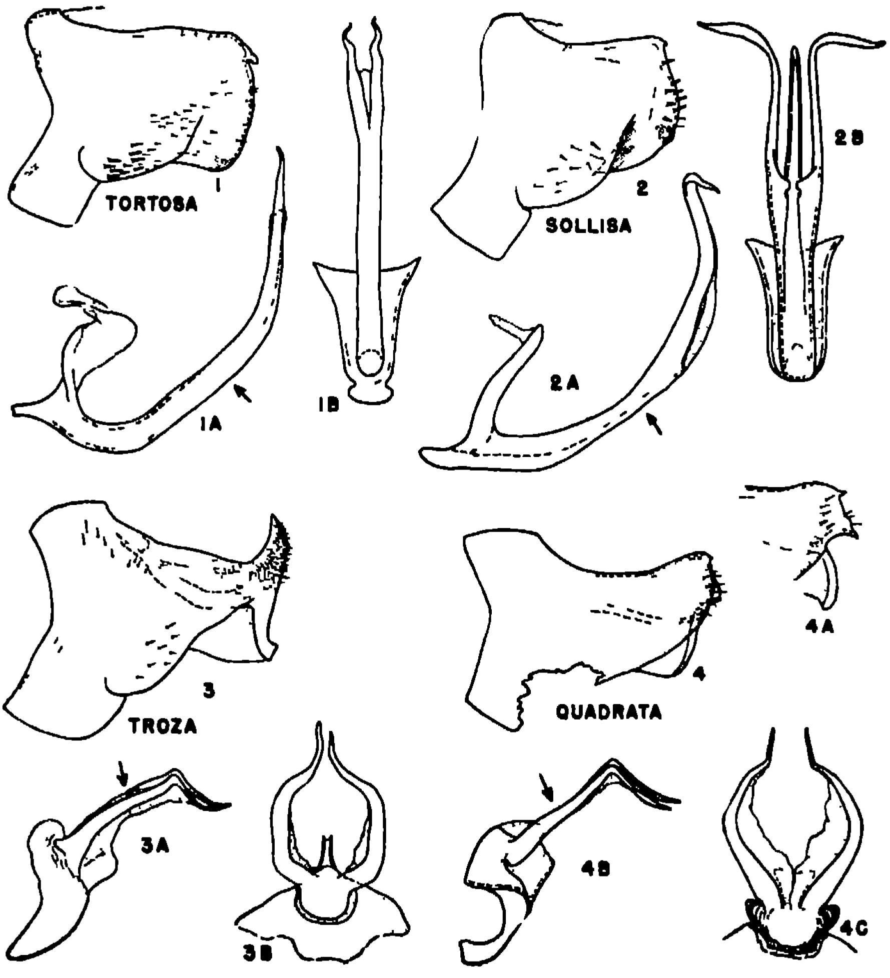
[1] *Revision of the American Leaf Hoppers of the Jassid Genus Typhlocyba* Proc U S N, M 68 1-47, 6 pl 1926

Holotype, male—Oakwood, Illinois, June 14, 1936, C O Mohr

Typhlocyba sollisa new species

This species is most closely related to ***putmani*** Knull differing in having the phalicata subdivided less than half way to its base in forming the mesal and pair of lateral processes, fig 2 The lateral processes are also curved to nearly a right angle and the base of the aedeagus is narrow in lateral view Length male 3 5 mm

Color pale yellow, with paler areas on vertex, pronotum and scutellum The wings darker yellow subhyaline to the cross veins The veins conspicuously yellow Apex subhyaline, not tinted



Male Genitalia of *Typhlocyba*

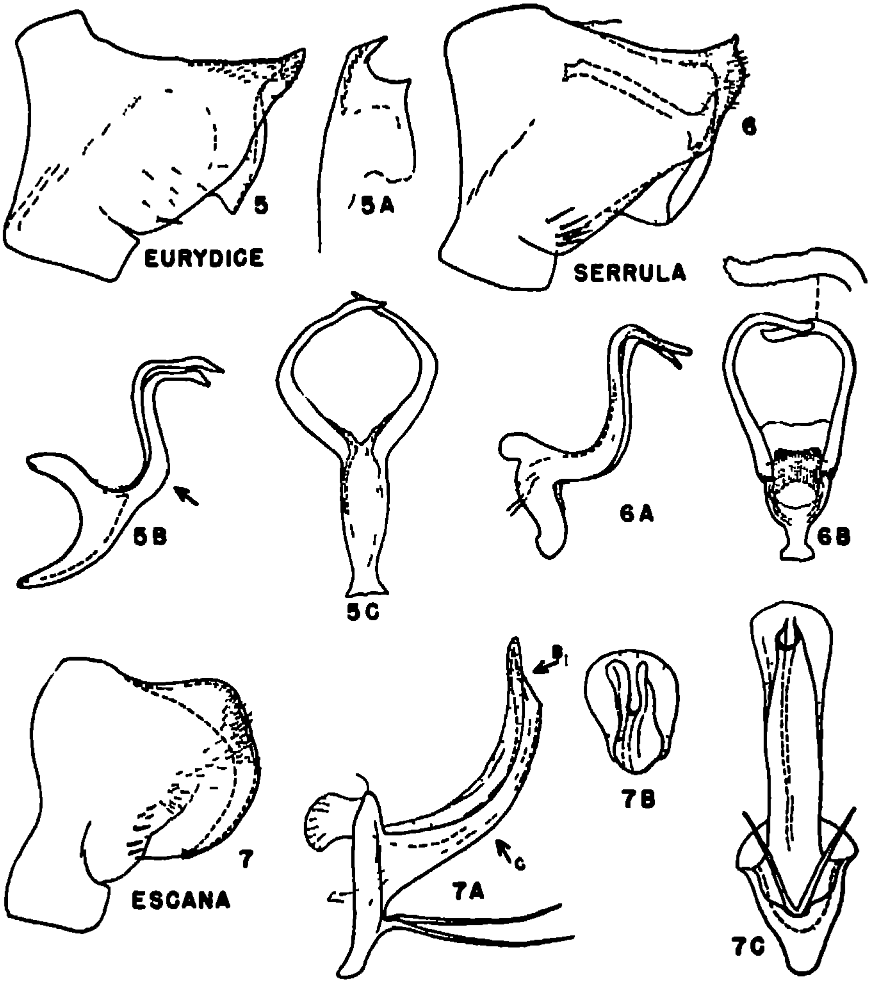
Fig 1 *T tortosa* n sp pygofer lateral aspect 1*A*, aedeagus, lateral aspect, 1*B* aedeagus posteroventral aspect from direction of arrow in 1*A* Fig 2 *T sollisa* n sp pygofer lateral aspect 2*A* aedeagus lateral aspect 2*B* aedeagus posteroventral aspect from direction of arrow in 2*A* Fig 3 *T troza* n sp, pygofer lateral aspect, 3*A* aedeagus lateral aspect 3*B* aedeagus dorsal aspect from direction of arrow in 3*A* Fig 4 *T quadrata* D & J pygofer, lateral aspect, 4*A* tip of pygofer posterolateral aspect 4*B*, aedeagus, lateral aspect, 4*C*, aedeagus dorsal aspect from direction of arrow in 4*B*

Male pygofer rather broad at apex without apical spine Aedeagus with the phallicata divided at more than half its length to form three processes, a slender mesal process and a pair of lateral processes which are slender, rather widely separated, extending apically almost parallel to near apices which are divergent and curved apically

Holotype, male—Grand Tower, Illinois May 30, 1935, Ross and Mohr

Typhlocyba troza new species

The curious shape of the aedeagus indicates a very close relationship between this species and *quadrata* D & J , but the two differ markedly in characters of the pygofer In *troza* this structure ends in a long vertical sharp projection which continues ventrad into a stout arm,



Male Genitalia of *Typhlocyba*

Fig 5 *T eurydice* McAtee pygofer lateral aspect 5A pygofer posterior aspect 5B aedeagus lateral aspect 5C, aedeagus posteroventral aspect from direction of arrow in 5B Fig 6 *T serrula* n sp , pygofer lateral aspect 6A aedeagus lateral aspect 6B aedeagus, posterolateral aspect same orientation as for 5C Fig 7 *T escana* n sp pygofer lateral aspect, 7A aedeagus, lateral aspect 7B phallicata from direction of arrow B in 7A 7C, aedeagus, ventral aspect from direction of arrow C in 7A

In Figs 1-7 illustrations of the aedeagus are 1 5 times the magnification of the pygofer

Fig 3, in *quadrata* the pygofer has no such projection, but instead curves mesad and forms an irregularly and obliquely truncate lobe, Figs 4, 4A The two differ also in details of the aedeagus. In *irosa* the dorsal part of the base of this structure is narrow and the lateral arms form an almost rectangular enclosure, Figs 3A, 3B, in *quadrata* the dorsal part of the base extends laterally beyond the base of the arms, and the lateral arms themselves are more parenthesis-shaped In both species it is difficult to identify the phalicata with certainty, but it appears to be a membranous projection arising between and beneath the large lateral arms Length 3 5 mm

The vertex is strongly produced and somewhat conical

Color, white strongly tinted with yellow on the vertex, pronotum and scutellum Wings distinctly yellow, subhyaline, a broken brownish band composed of four spots just before the cross nervures anterior to the apical cells

Holotype, male—Karnak, Illinois, June 14, 1934, DeLong and Ross

Typhlocyba serrula new species

This species is most closely related to *eurydice* McAtee, from which it differs in characters of the pygofer and aedeagus The pygofer is pointed Fig 6 somewhat as in *eurydice*, Fig 5, but lacks the mesal flap with its sharp dorsal point which is characteristic of *eurydice*, Fig 5A In *serrula* the aedeagus is much more sharply sinuate in lateral view, Fig 6A, and has longer arms and a shorter base in postero-ventral view Fig 6B Length 4 mm

Color, white without markings, wings white subhyaline

The aedeagus in postero-ventral view has a shorter basal portion, the arms are longer, more widely separated at the base, and the apices are thicker and more blunt than in *eurydice*

The female sternite is roundedly produced

Holotype, male allotype female and female paratypes—Waynesburg, Pennsylvania, July 17, 1919, D M DeLong Male paratype—N Bloomfield, Pa, July 16, 1920, J G Sanders Holotype, allotype and paratypes in DeLong collection, paratype in Illinois Natural History Survey collection

Typhlocyba escana new species

In characteristics of pygofer and style this species belongs to the *rubriocellata* group but differs from *rubriocellata* and related species in the undivided long curved phalicata and the pair of slender ventral processes, Figs 7A, 7B 7C Length male 4 mm

Color, white, scutellum embrowned Wings white, the claval area unmarked, apical portion smoky, intensified anteriorly to form a broad brownish band across the cross nervures. A transverse yellowish band is just anterior to the brownish portion There is a reddish area on the median basal half of the wing just anterior to the clavus The costal margin is white

Male pygofer broad at apex The aedeagus phalicata in lateral view is rather broad, curved dorsally and tapered to a narrow apex The postero-ventral portion is convexly inflated, not reaching the apex of the anterior portion and open at the middle at apex There is a pair of rather long slender processes which arise below the phalicata at base and extend caudally

Holotype, male—Alum Cave parking area, Great Smoky Mountains National Park, Tennessee, August 31, 1948, on *Aesculus*, Ross and Stannard Allotype female—Chimneys Camp Ground, Great Smoky Mountains National Park, Tennessee, August 30, 1948, on *Aesculus* Paratypes—Same data as for holotype, 1 male, same data as for allotype, 2 females

Typhlocyba quercus (Fabricius)

A series of this palearctic species was taken in western British Columbia on Queen Anne cherry, and apparently constitutes a new record for North America The data of collection are Vancouver, B C July 15, 1946, H H Ross

This pretty species is brightly colored with a mottled red pattern, and superficially looks very much like some of the showy members of the *Comes* group of *Erythroneura* The short style, elongate and cylindrical phalicata, and the long twisted ventral processes of the aedeagus distinguish this species from any North American members of the genus These characters have been illustrated in detail by Ribaut 1936 (Faune De France 31 123, figs. 317–323) We are indebted to Dr Oman for confirming the identification of this new introduction The species is recorded in Europe on oak, plum, cherry, and other hosts

NEW LEAFHOPPERS FROM THE UNITED STATES (HOMOPTERA CICADELLIDAE)[1]

DOROTHY J KNULL,
330 E Dunedin Road Columbus 2 Ohio

Stragania (Penestragania) hualpaiana n sp

Resembling S *robusta* (Uhler) but with a distinctly swollen produced head and elytra more thickly set with short black setae

Vertex swollen roundedly produced over half its length before eyes narrower than pronotum, twice as long as vertex elytra thickly set with evenly spaced very short black setae arising from small brown round spots over entire elytra, except appendices Pronotum transversely striate

Color pea green, veins and feet brighter blue green, head pronotum and scutellum washed with golden yellow elytra greenish semihyaline

Genitalia Posterior margin of ♀ last ventral segment excavated slightly from lateral angles and very slightly produced at middle, entire Pygofer of ♂ with large hook bent in at almost a right angle at middle, tapered on outer fifth from hump on inside to sharp point styles small, inner margins straight, outer margins curved gently from base, broadest before middle, tapering to apices which turn out abruptly and are sharptipped Aedeagus as in *S robusta* (Uhler)

Length ♂ 4 5 mm , ♀, 5 mm

Holotype ♂ *allotype* 18 ♂ *paratypes* and 29 ♀ *paratypes* Hualpai Mts Arizona June 2, 1948 3 ♀ paratypes, July 4 1937, collected by D J & J N Knull, and placed in collection of The Ohio State University

The three ♀ specimens taken in 1937 were sent to Dr Beamer some time ago He marked them '*S* (*Penestragania*) sp —need ♂'s ' The series taken in 1948 included ♂'s and proved to be an undescribed species

Stirellus subnubilus n sp

A dark winged species with pale, conical head

Head as wide as pronotum, vertex slightly less than one-third longer at middle than width between eyes, less than twice as long at middle as next to eyes, eyes large Pronotum 2⅔ times as wide as long, length at middle about ¼ shorter than vertex, lateral margins very short, humeral margins long, posterior margin very slightly emarginate, disc irregularly wrinkled, margins, scutellum and vertex finely granulate Elytra exceeding apex of abdomen in ♂, slightly exceeded by ovipositor in ♀

Color Vertex pale, a pair of large black discal spots, rather square, another pair on basal disc, elongate dashes, eyes gray Pronotum dark brown on disc darker at margins, with some yellow irregular spots along anterior margin Scutellum with basal angles, median square between them, and apical triangle black separated by narrow yellow lines and margins. Elytra dark brown, veins a little darker, especially apically, appendix and apical cells somewhat paler, semi hyaline. Below, face and antennae pale, remnants of six short dark arcs either side, a line below clypeal suture and apical two-thirds of clypeus dark, also lower half of lorae antennal socket area, and region bordering eyes Venter and dorsum dark, segments narrowly yellow margined, apex of pygofer in male pale, legs dark with pale spines, ♀, legs paler, ovipositor, basal area and spines of pygofer pale

Genitalia Female last ventral segment as long as preceding, evenly, faintly emarginate from rounded sides to middle, ovipositor exceeding pygofer by about twice its greatest width, its apex set with fine white hairs, about 7 long pale spines either side on pygofers males with triangular valve, produced apically in a sharp pale spine, plates twice as long and broad as valve (without spine), together forming semicircle, outer submargin of each set with six long pale

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[1] The author acknowledges with gratitude payment for plates by grant from the Ohio Academy of Science Research Fund

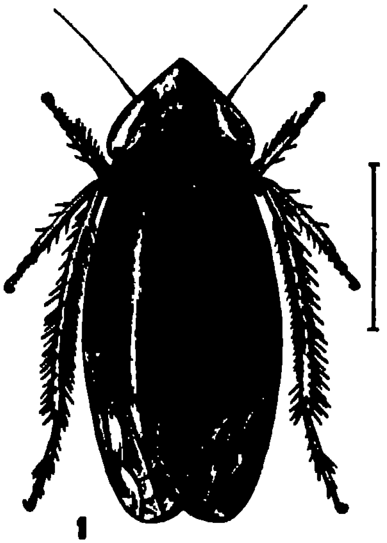
spines evenly spaced pygofer extends a third below plates truncate, pale swollen inner apical angles conspicuous

Length ♂ 2 8 mm , ♀, 3 5 mm

Described from specimens taken in Mississippi in 1922 by Herbert Osborn in the Osborn Collection The Ohio State University

♂ *holotype*, Ocean Springs Febr 25 *allotype* and 1 ♂ *paratype*, Febr 2 2 ♀ and 1 ♂ *paratypes*, Hurley, Febr 25 1 ♀ *paratype*, Wade, Febr 24

In form this species is closest to *Stirellus dixianus* var *acutus* Thomas but the coloring is very distinct



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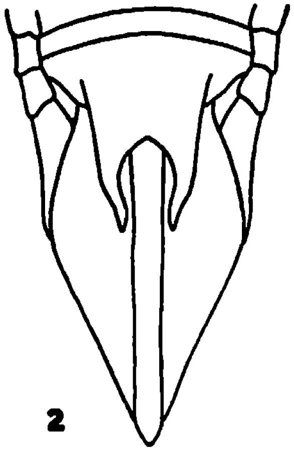

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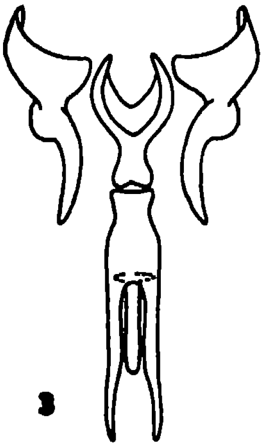

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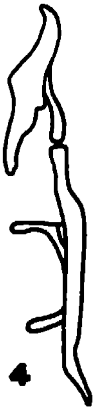

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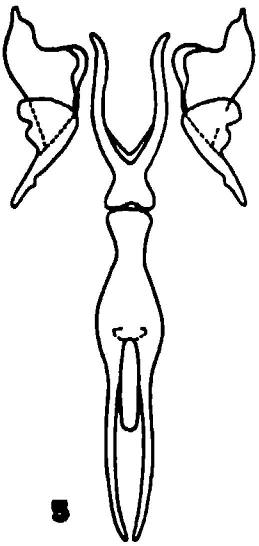

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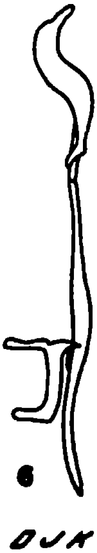

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FIG 1 *Stirellus nubilus* Knull—line = 1 mm FIG 2 *Spathanus excavatus* Knull—ventral view of ♀ abdomen 3 *Spathanus aureus* Knull—ventral view inner ♂ genitalia FIG 4 *Spathanus aureus* Knull—lateral view inner ♂ genitalia FIG 5 *Spathnus acutus* Knull—ventral view inner ♂ genitalia FIG 6 *Spathanus acutus* Knull—lateral view inner ♂ genitalia

Three species are described in the tightly knit genus *Spathanus*, two from California and one from Nevada Creosote bush (*Larrea tridentata* var *glutinosa* Jepson) is a food plant of all species known All specimens are placed in the collection of The Ohio State University

Spathanus mirus (Van Duzee)

Scaphoideus mirus Van Duzee, Proc Calif Acad Sciences 14 419–20, 1925

Osbornellus mirus (Van Duzee), DeLong & Knull, Check List of Cicadellidae, Grad Studies, The Ohio State University Press, 1 32, 1945

Spathanus acuminatus (Baker), Oman, Jour N Y Ent Soc 55·61, 1947

I am indebted to Dr P W Oman and Dr Edward S Ross for their help in determining the status of *Spathanus mirus* (Van Duzee) My study of specimens along with their comments, and Dr Ross s notes on the type, convince me that *S mirus* is a valid species

Spathanus acutus n sp

Immediately distinguished by pale vertex, pronotum, scutellum and basal third of clavus in distinct contrast to darker remainder of elytra In ♂ plates are longer than in *acuminatus*, attenuate apices almost reaching apex of pygofer

♂ Vertex roundedly produced, one-third broader at base than median length, pronotum longer than vertex, hind margin almost straight elytra considerably longer than abdomen, apices rounded, apical cells short

Color Vertex golden, median longitudinal impressed black line from base two-thirds distance to apex eyes dark brown front dark with about eight pale arcs either side, dark coloring of front showing a little from above pronotum sordid yellow, more golden anteriorly, with some irregular transluscent mottling scutellum yellow, basal angles gray, transverse black impressed line before apex, elytra milky white on basal third, below marked with fuscous veins and cells of corium, apical and anteapical cells with discal round pale spots surrounded irregularly with dark brown, posterior two-thirds of clavus dark brown with two oval pale spots along suture Below brown, dorsum darker

Last ventral segment of ♀ about length of preceding, lateral angles incised half their length next to broad produced median process, a little wider than a third narrowed only gently toward apex which is shallowly roundly excavated between two sharp teeth, this process extends from base of segment one-half length of ovipositor shorter than in *acuminatus*

♂ plates long, triangular attenuate on apical third almost attaining apex of pygofer styles short, broad at base, narrowed and produced on inner angle in small narrow apex shaped like a toe-dancer's foot, the toe pointed down and out Aedeagus with pair of long slender straight processes narrowed to sharp incurved apices exceeding attenuate plate tips in length, dorsal portion gently curved, attached near separation point of ventral processes with a short arm, tube extending two-thirds length of processes, turned dorsad at apex about as far as basal arm In lateral view ventral aedeagus slightly sinuate broad at base, blades narrow

Length ♂, 4 5 mm , ♀, 4 75 mm

Described from specimens taken from creosote bush by D J & J N Knull ♂ holotype, Santa Rosa Mts (Dos Palmos) Riverside Co Calif June 15 1946 1 ♂ and 1 ♀ paratype, same locality June 15 1948 3 ♀s allotype and paratypes, Palm Springs, Riverside Co Calif , June 30, 1946 1 ♂ paratype, June 15 1948

Spathanus aureus n sp

Above and below golden brown in color with markings faint but similar to those of *acuminatus*

♂ Plates long, triangular, attenuate apical third not quite as long as pygofer dark oblique dash on disc, styles heavy, inner angle produced in a long heavy blade curved out, blade almost as long as basal portion, aedeagus shorter and stouter than in *acutus* and *acuminatus*, ventral paired processes slightly sinuate, narrowed on apical half, apices dark sharp aedeagus shallowly U shaped, in lateral view apices of ventral arms turned ventrad Styles are unique character

♀ Segment as in *acutus*, concave, a little shorter, apex narrowed more abruptly

Length ♂ 4 75 mm , ♀, 5 mm

♂ *holotype* Shavers Well, Calif , Riverside Co , June 17, 1946, allotype and 1 ♂ *paratype* same data, 1 ♂ and 1 ♀ *paratype*, Yuma, Arizona, June 11, 1937 1 ♂ *paratype*, Morongo Valley, Calif , Riverside Co , June 5, 1946 Collected by D J & J N Knull

Spathanus excavatus n sp

♀ Short, robust, pale golden brown, veins of apices of elytra darker, five reflex veinlets on costa outside outer anteapical cell

Last ventral segment with lateral lobes one-third longer than preceding, rounded, incised one-half length next to median process process twice as long as broad, occupying median half of segment, tapered gradually from base, apex deeply excavated half way to base leaving two comparatively slender points which approach one another at their apices, median projection from base less than half length of pygofer

Length ♀, 4 5 mm

Described from 1 ♀ holotype, Las Vegas, Nev , June 30, 1937, D J & J N Knull

The last segment of the ♀ places this nearer to *S mirus* (V D) than to other members of the genus, but it is shorter, paler and more robust than *mirus*

Erythroneura flexibilis n sp

General ground color semihyaline to white tinged with yellow anteriorly, marked with bright red Vertex with short red transverse rectangle at apex two basal oval pale spots surrounded except at base by irregular red markings which join at middle Pronotum with median heart-shaped spot and an irregular spot behind either eye Scutellum with tip red and basal angles yellow narrowly red outlined Clavus with broad basal anchor-shaped spot and one before apex Corium with angulate mark arising on costa before humeral angle another irregular and broken angulate vitta arising on costa at anterior end of plaque more or less surrounding it and ending on mesal margin near tip of clavus in an enlarged area Crossveins and adjacent longitudinal veins red, apices of elytra smoky Large black spot in base of cell M_4. Below with spot before apex of vertex, area above antennae, face before clypeus and posterior tibiae red, remainder stramineus

♂ *genitalia* Pygofer hook single, of medium length, turned in on outer third sharp-pointed. Style with small foot, base curved heel about a right angle, anterior point less than right angle, projecting outward posterior point very slightly longer than base of foot, fine, sharp, meeting base at less than right angle Aedeagus of medium length, straight, in ventral view with lateral rough teeth, in lateral view with truncate tip

Length 3 mm

♂ *holotype*, Delaware Co , Ohio March 18 1945, ♂ *paratypes*, Delaware Co , O , 1 March 18, 1945, 1 March 25, 1945, 1 August 13, 1944 3 Highland Co , O , June 6, 1945 all collected by D J and J N Knull, 2 Hartwick St Park, Mich July 19, Mary Auten 1 Cranberry Lake, N Y , August 9, 1920, Osborn & Drake (in the Osborn Collection, The Ohio State University)

Runs to *E torella* Rob in Beamer's key[9] but differs in more abrupt turn in pygofer hook, size of aedeagus, and shape of style

Erythroneura dimidiata n sp

Small, general round color semihyaline to yellowish white marked with orange Vertex with five white spots narrowly bordered with orange. Pronotum with median Y shaped mark not reaching either edge angulate vitta behind either eye Scutellum with red apex, yellow basal angles Clavi with basal anchor sharped spot, and one before tip, coria with spot on costa before base irregular blotches surrounding three sides of costal plaque and spot below apex of clavus Crossveins and adjacent longitudinal veins narrowly red Faint black spot in base of cell M_4, tips of elytra faintly smoky Venter white and stramineus with some pink tinges.

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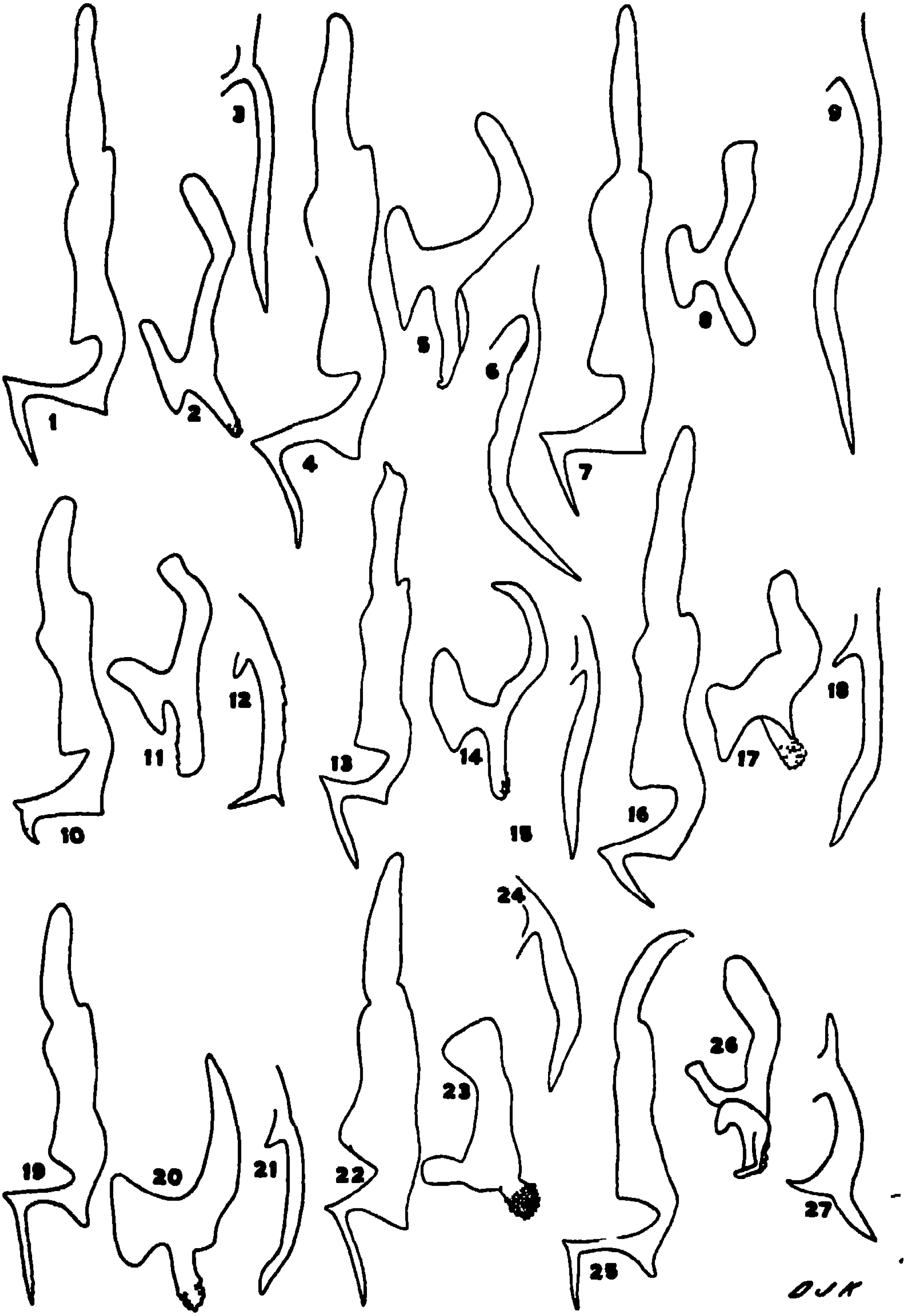
[9] R H Beamer Can Ent , 64 174 1932

EXPLANATION OF PLATE II

Figs 1, 2, 3 Style, aedeagus, pygofer hook, *Erythroneura malaca* Knull Figs 4, 5, 6 Style, aedeagus, pygofer hook, *Erythroneura hymettana* Knull Figs 7, 8 9 Style, aedeagus, pygofer hook, *Erythroneura proluxa* Knull Figs 10, 11, 12 Style, aedeagus, pygofer hook, *Erythroneura uvaldeana* Knull Figs 13, 14, 15 Style, aedeagus, pygofer hook, *Erythroneura severini* Knull Figs 16, 17, 18 Style aedeagus, pygofer hook, *Erythroneura flexibilis* Knull Figs 19, 20, 21 Style, aedeagus, pygofer hook, *Erythroneura direpta* Knull Figs 22, 23, 24 Style, aedeagus, pygofer hook, *Erythroneura luculenta* Knull Figs 25 26, 27 Style, aedeagus, pygofer hook, *Erythroneura dimidiata* Knull



♂ *genitalia* Pygofer hook single, curved in, with apex broadened and separated in diverging wings, outer a continuation of base, inner not quite as large and turned up, both sharp Style with large thin foot, base straight, heel large, rectangular, anterior point about a right angle, posterior point about half length of foot, narrow, sharp, parallel sided Aedeagus of medium length, broad with narrow transverse lip at apex

Length 2 5 mm

Holotype ♂ from Hocking Co , Ohio, June 28, 3 ♂ *paratypes* taken in Hocking Co , Sept. 16, 1943, Sept 14, 1944, and May 8, 1938 by D J & J N Knull Types in collection of author

This species runs to *E californica* Beamer[3] but resembles *E minor* Beamer more closely in character of inner male genitalia

Erythroneura hymettana n sp

Background white marked with red, brown and black Vertex brown with elongate median spot pale, an apical red streak on either side of which is a small white spot Pronotum tan, paler at posterior margin and darker in area surrounding three marginal anterior pale spots Scutellum with basal angles tan and apex shining black, slightly raised as seen from side Elytra with two red dots, one claval and one corial at humeral angles, spots either end of costal plaque, elongate red streaks somewhat broken into dots in an oblique transverse band from plaque to apex of clavus, this band is parallel to one formed by red crossveins and adjacent longitudinal veins, between bands opaque white. A large quadrate gray brown spot covering middle of clavus, another, large and just below it on corium, extending to costal plaque which is hyaline Apices dark Small black dot at base of cell M_4 and a dark streak at posterior end of plaque Below stramineus, mesothorax dark, also dorsum of abdomen and anterior margins of ventral abdominal segments last ventral segment and apices of plates in male also dark with pale band between

♂ *genitalia* Pygofer hook longer than pygofer, ribbon like, narrowed at base, broadening slightly, turning in a little at middle, then out on sharply pointed apical fourth Style with large foot, base strongly curved, heel pointed down, less than a right angle, anterior point small and projecting out posterior point longer than foot, tapering to sharp-pointed apex which turns out Aedeagus long, narrow, broader at base and tapering to tip which is turned sharply dorsad in a small lip

Length 3 1 mm

Described from 4 ♂ specimens collected by D J & J N Knull, 2 from Hocking Co , O , holotype, April 11, 1945, paratype Sept 14, 1945, two paratypes, Fairfield Co , Ohio, May 12 1947

The unique coloring and raised blackened tip of scutellum, which is reminiscent of the genus *Hymetta* make this form very outstanding It may be related to *E lunata* McAtee, and fits the description fairly well but the genitalia are quite distinct from those illustrated by Beamer[3] (Fig 5), and nearer to those of *E septima* Beamer[3] (Fig 69) The dark markings in *E hymettana* are much broader, and more diffuse than in either of the two species, and it is more definitely a member of the Maculata group

Erythroneura luculenta n sp

Large, background white, semihyaline with orange to red markings Vertex more sharply produced than in most members of the Maculata group and with more pointed apex Vertex marked with five oral white spots surrounded by vittae in which red coloring is accentuated in two median basal and median apical dashes Pronotum white with median heart shaped spot and small angulate mark behind either eye Scutellum pale in holotype, red tipped and yellow basal angles outlined in red in some specimens. Clavus with anchor spot on basal half, spot before apex, small humeral spot, and angulate vitta on corium surrounding plaque and extending over to area below apex of clavus Outer crossveins and adjacent longitudinal veins reddened, latter only briefly and before crossveins Large round black spot in base of M_4 and smaller one at posterior margin of plaque. Tips of wings clouded faintly

♂ *genitalia* Pygofer hook heavy on basal half, tapering to sharp tip on outer half which is curved in distinctly Style small base curved, heel large, protruding, less than right angle, anterior point small, projecting, posterior point longer than foot narrow, tapering to fine point, meeting base at less than right angle Aedeagus short, quadrate, rough lateral edges, appearing cut off in lateral view, and broader at tip than at base, almost quadrate in ventral view

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[3] R N Beamer, Can Ent , 64 174, 1932

Length 3 2 mm

♂ holotype, Oak Creek Canyon, Arizona August 1, 1938 allotype August 15, 1938, ♀ paratypes, 1 August 1, 1938, 2 August 15, 1938, 1 July 13, 1940 2 ♀ paratypes, Flagstaff, Arizona, July 30, 1938

Runs to *E dira* Beamer in key[4] but is closer in general appearance to *F lorella* Rob from which it differs chiefly in form of aedeagus

Erythroneura uvaldeana n sp

Rather small species with ground color white to cream, semihyaline on elytra, marked with golden orange to scarlet Vertex with narrow elongate median pale oval margined entirely and evenly with broad vitta which on either side at middle has fainter lateral extensions to eyes Pronotum with large median Y almost reaching both margins, large triangular spot behind each eye Scutellum with basal angles yellow orange and apex orange Elytra with basal anchor spot on clavus, another before apex irregular marking extending from below outer humeral angle on corium, around costal plaque and from its lower inner corner obliquely to area below apex of clavus Outer crossveins and adjacent longitudinal veins reddened, inner pale Small black spot in base of cell M_4 a minute one at lower edge of plaque, tips of tegmina fumose Highly marked specimens taken in June have elytra vittae broad and continuous

♂ genitalia Pygofer hook narrow to outer half where it broadens slightly and forms two spines at its apex, outer a short sharp spine continuous with outer margin, inner much larger and turned in abruptly at not much more than a right angle from outer spine Style with medium foot with fairly heavy, straight base rectangular heel and anterior point, posterior point a short sharp incurved barb, about 1/4 length of foot Aedeagus as long as foot a straight narrow tube from any view

Length 2 8 mm

Described from twelve specimens from Uvalde Texas collected by D J & J N Knull ♂ *holotype* and *allotype*, 2 ♂ and 4 ♀ *paratypes*, August 4, 1937, 2 ♀ *paratypes* June 3 1939, 2 ♀ *paratypes*, June 26, 1940 These were taken from oak in Garner Park

Near *E bispinosa* Beamer, but differing in form of apical spines of pygofer hook and form of aedeagus

Erythroneura severini n sp

General ground color creamy white, semihyaline elytra, markings orange, small and distinct Vertex with faint traces of median orange encircled oval pronotum with small median triangle in middle angles of scutellum deeper cream Clavus with narrow basal anchor shaped vitta not touching any margin and small spot before apex corium with four spots around plaque and one above cell M_4, crossveins irregularly red, dark spot on base of cell M_4 small Venter cream and white

♂ *genitalia* Pygofer hook single, stout, broader near middle, slightly S-curved, tapered to sharp apex style with narrow foot, base straight, heel a little sharper than a right angle, anterior point projecting slightly, posterior point longer than foot, narrow straight sided sharp Aedeagus long and narrow, straight, with a few spines in front

Length 2 5 mm

Holotype ♂ *allotype* 3 ♂ and 1 ♀ *paratypes* Hot Springs, S D Sept 17, 1919, 1 ♂ and 1 ♀, August 27, 1922, Raspberry, H C Severin Two *paratypes* sent to Dr Severin, for whom the species is named

Resembles *knighti* Beamer, but has narrower aedeagus and shorter pygofer hook Runs to *E usitata* in Beamer's key [4]

Erythroneura direpta n sp

General ground color yellowish white to semihyaline Markings orange to red, diffuse. Vertex with three white spots surrounded by narrow irregular orange bands Pronotum with median Y-shaped vitta and spot back of each eye. Scutellum with orange spot on tip and basal angles yellow Clavus with basal anchor-shaped spot and one near apex, corium with spot on costal at humeral angle, irregular one at anterior end of costal plaque, two streaks at posterior end, rectangular one at clear space opposite apex of clavus and a streak before base of cell M_4. Medium sized black spot in base of cell M_4 and small one in posterior end of plaque. Venter cream

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[4] R H Beamer, Can Ent, 64 174, 1932

♂ *genitalia* Pygofer hook angle, heavy, straight, turned in slightly toward tip, very slightly enlarged before apex, style with large foot, base curved, heel prominent, anterior point distinct, blunt, posterior point longer than foot, narrow, sharp-tipped, inner margin irregular Aedeagus oblong with spiny irregular apex, longer behind than in front in lateral view

Length 2 5 mm

Holotype ♂ Hocking Co , Ohio, July 16, 1945, *allotype*, April 26, 1938, *paratypes*, 2 ♂, April 17, 1938, 3 ♂ and 1 ♀, April 26, 1938, 1 ♂, May 8, 1937, D J & J N Knull 5 ♂ *paratypes*, Ashland Co , Ohio, Sept 29, Mary Auten Delaware Co , Ohio, 3 ♂, May 19, 1943, Sept 4, 1944, Oct 3, 1943, D J & J N Knull 3 ♂, Knox Co , Ohio, August 28, 1938 Mary Auten, 3 ♂, Scioto Co , Ohio, June 1, 1945, D J & J N Knull

Close to *E certa* Beamer in character of inner male genitalia and also resembles *E dura* Beamer, but differs from the former in longer base of style, and from latter in longer aedeagus and pygofer hook

Erythroneura prolixa n sp

General ground color white marked with broad orange vittae. Vertex with three oval imperfectly orange-margined pale spots. Pronotum with median Y reaching both margins, large angular spot behind each eye. Scutellum with apex orange, basal angles yellow, outer margins orange. Clavus with basal broad anchor shaped spot, elongate spot before apex, corium with diagonal vitta below humeral angle to anchor spot of clavus, one on three sides of plaque with diagonal extension toward apex of clavus Crossveins red, black dash at posterior end of plaque and large round black spot in base of cell M_4. Below, white and cream

♂ *genitalia* Pygofer hook extraordinarily long, almost as long as style, gently S-curved, wider at inner curve near middle, sharp-tipped Style large, base broad, straight, heel large, projecting slightly, anterior point projecting about 45° angle, posterior point narrow, sharp, straight, meeting base at about a right angle a little shorter than base Aedeagus long, smooth, oval

Length 3 mm

♂ *holotype*, Hocking Co , Ohio, May 5, D J & J N Knull, 1 ♂ *paratype*, Pickaway Co , Ohio, Febr 20, J S Caldwell

Nearest *E incondita* Beamer, from which it differs in shape of aedeagus and width of style

Erythroneura malaca n sp

Anterior ground color cream, of elytra white semihyaline, markings pale orange, eyes dark Usual markings of head pronotum and scutellum faintly indicated Clavus with basal anchor and spot before apex, corium with dot at humeral angle, two irregular parallel bands originating at each end of plaque and extending, anterior one to spot near apex of clavus, and posterior to point below apex of clavus, outer crossvein bright red, black spot in base of cell M_4 and dot in posterior margin of plaque, apices smoky hyaline. Below cream colored

♂ *genitalia* Pygofer hook long, straight, heavy, a little broader below middle, tapered to sharp tip Style with large slender foot, base straight, heel protruding, anterior point short, less than right angle, posterior point meeting base at less than right angle curve, directed in, almost as long as base, narrow, sharp Aedeagus triangular, tapered to spiny tip, longer than broad

Length 2 75 mm

♂ *holotype*, Highland Co , Ohio, June 6, 1945, D J and J N Knull, 1 ♂ *paratype*, Lawrence Co , Ohio, April 29, J S. Caldwell

Near *E macra* Beamer but with stouter, straighter pygofer hook.

All specimens of *Erythroneura* are retained in collection of author unless other deposition is mentioned

A NEW SPECIES OF DRAECULACEPHALA FROM CALIFORNIA (HOMOPTERA, CICADELLIDAE)

RALPH H DAVIDSON,
Entomological Laboratories Ohio State University
AND
NORMAN W FRAZIER,
Division of Entomology University of California

This new species closely resembles *Draeculacephala minerva* Ball and at first was thought to be the same but attempts at cross-breeding have been unsuccessful thus indicating that it is definitely new It has been proven to be a vector of a virus disease of grapes in California

Draeculacephala californica n sp

Resembling *minerva* in general appearance this species is slightly longer and narrower bodied with the vertex more produced and the apex of the vertex more acute. In profile view the face is slightly concave while in *minerva* it is slightly convex.

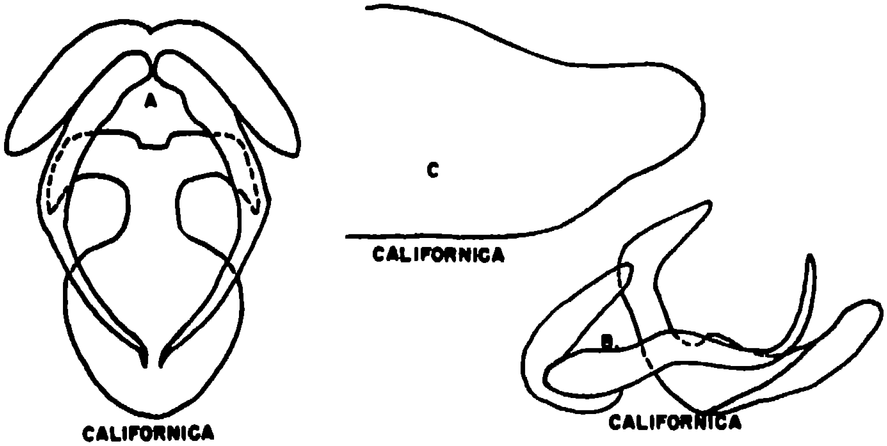

FIG 1 A Ventral view of internal male genitalia B Lateral view of internal male genitalia C Lateral view of pygofer

Color The vertex, anterior portion of pronotum and scutellum are greenish yellow There are also a few very faint brownish lines on the vertex The posterior portion of the pronotum and elytra are dark green with pale green veins The body of both males and females is light yellow to cream color beneath with slightly darker colored faces, while in *minerva* the face and underside of the body of the male is black and in the female light yellow

Genitalia In the female the last ventral segment has a median produced, rounded apex and concave lateral angles. The male plates are nearly as long as the pygofers and gradually narrowed to pointed rounded apices. The styles are short and broad with the apical portion bent inward and narrowed abruptly to sharp pointed tips The aedeagus in lateral view has a pair of short, stout, dorsally-directed basal processes. Posterior to them is another pair of long, slender processes which from ventral view curve outwardly at half their length and then inwardly, gradually tapering to slender pointed tips which are directed upward The basal portion of the aedeagus proper is bifurcate with stout, dorsally-directed pieces It has a ventral, convexly rounded, broad portion with a gently rounded apex that is directed posteriorly and upward

Holotype male, allotype female, and a male and female paratype in the Ohio State University collection were all collected by the junior author at Oasis, California, on May 28, 1946 A pair of paratypes from the type series is deposited in each of the following collections U S. National Museum, Washington, D C , Snow Collection, University of Kansas, University of California and California Academy of Science Twelve pairs of paratypes from the same series, and seven male and ten female paratypes from Oasis, Calif , collected on 6-6-42 (Frazier) and one male and three female paratypes from Berkeley, California, June 1942 (Frazier), are all deposited in the collection of the junior author One female and ten male paratypes from Brawley, Calif (Webster No 7090) seven male paratypes from Yuma, Arizona, July 20, 1907 a pair of paratypes from Yuma, Arizona, June 11, 1937, collected by D J and J N Knull one male and three female paratypes from Holtville, California, collected by V L Wildermuth a pair of paratypes from El Centro, California (Webster 7089) one male paratype from Imperial, California, collected by V L Wildermuth, and one male from Palo Alto California July 14, 1892, all in the Herbert Osborn Collection, Ohio State University

THE OHIO JOURNAL OF SCIENCE

VOL XLIX JULY, 1949 No 4

APE OR MAN?

AN INCOMPLETE CHAPTER OF HUMAN ANCESTRY FROM SOUTH AFRICA[1]

GEORGE B BARBOUR
University of Cincinnati

Psychology can no doubt account for the almost morbid interest modern man displays in his ancestors and their humbler relatives The deader they are, the more fascination they seem to hold for him Nor is he deterred by finding that some were hanged for sheep-stealing or eaten for cannibalism Mere reference to a "missing link" is good for a 96-point news headline at any time

The particular group of near-relatives whom I wish to present to you this evening are some whose remains came to light recently in South Africa The finds were made at sites I visited some months ago, thanks to invitations from the Archaeological Survey of South Africa, the University of the Witwatersrand at Johannesburg, the Bernard Price Foundation, and the University of California's African Expedition under Dr Charles L Camp, of which I was privileged to be a member[2] While the fossil finds themselves have received wide notice in the scientific press, much less has been said about their field-setting and the broader problems they involve These range beyond the confines of the anatomist's laboratory, and call for a concerted attack by geologist, stratigrapher, physiographer, climatologist, anthropologist and paleontologist alike The critical questions still await precise answers Perhaps this only makes an interim report of progress the more appropriate at this time

South Africa, the sub-continent from the Zambesi to the Cape, is a large place—almost half the size of the continental United States One may think of it as a shield-shaped platform of older deformed rocks, worn down by weather and water to a surface of low relief, and then buried by a thick cover of flat-lying younger layers—mainly sand and silt, glacial debris, and lava These younger strata—the earliest dating back to the days of the swamp forests which became the Coal Measures of Pennsylvania—take their name from the barren Karroo plateau-land which they build The distorted older formations on which they rest range from early Pre-Cambrian to Mississippian in age The whole platform, originally considerably larger than it is today, was buckled and broken down along its southern and south-eastern margin, and faintly warped in the interior But otherwise it has stood remarkably stable over a span of later geological time measurable in many tens of millions of years—long enough for much of the flat Karroo overlay to be stripped off down to the older foundations, and for the heart of the region to be blanketed with the sand of the Kalahari desert

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[1] Presidential address delivered before the Ohio Academy of Science, at Denison University, Granville, Ohio April 22, 1949

[2] I am under personal debt to my Johannesburg host Dr Raymond Dart, to the late Dr Alex DuToit, dean of South African geologists to Dr Sidney Haughton, Director of the Geological Survey, to Prof C van Riet Lowe Director of the Archaeological Survey Prof J C van der Horst and other members of the Bernard Price Foundation, as well as to scientists who guided me in the field—especially Dr Robert Broom, Dr B M Malan Dr H B Cooke, and my colleague, Dr Frank Peabody

The coast, like that of Europe and North America, preserves in places the etch-marks of wave action and traces of marine veneer which record the fall and rise of sea-level—due either to the refrigeration and melting of the Great Ice Age, or to the slow faint heavings of the Earth's crust In the extreme south the Cretaceous sea had pushed two long arms inland between flanking ranges, while a brief still earlier incursion of ocean waters formed the shallow Bokkeveld Sea (Lower Devonian) But with these exceptions, virtually the entire area has stood above sea-level since the dawn of the Paleozoic Era

Thus South Africa has been uninterruptedly "continental" since before forests first appeared on the earth, when primitive fishes were the most advanced form of life, indeed, if we exclude the area flooded by the Bokkeveld Sea, since the days when backbones were still inventions of the future, and the master race on the planet were the sea-faring molluscs and their humbler relatives Hence the region offers a chance to find new paragraphs in the fragmental record of what must have been a continuous evolution of land-inhabiting creatures

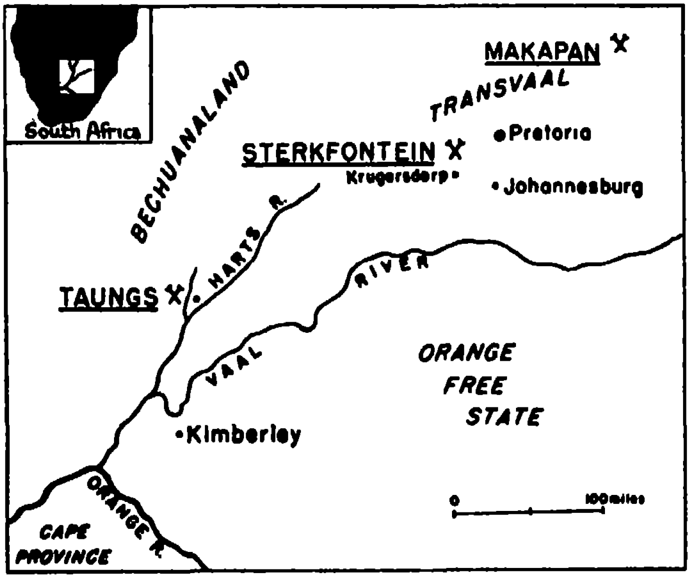

FIG 1 Location of Australopithecine sites

A century ago (1856) A G Bain first astonished the geological world by finding superb reptile remains in the Karroo strata (1) Others followed in his footsteps To Dr Robert Broom goes credit for awakening the government to the scientific importance of these national treasures in the Karroo It may be interjected in passing that Dr Charles Camp of the University of California, himself an authority on reptilian fossils, was already familiar with the region, and at the invitation of General Smuts made it a primary objective of his expedition in 1947–1948

The Karroo reptiles had their heyday, and in due time gave place to four-footed mammals, and these in turn to the rarer two-footed ones of which I speak tonight The reason for their rarity is obvious The present era is one of denudation, and when a land surface is being worn down at an average rate of about a foot in 1500 years (2), such perishable objects as skeletons are soon destroyed Indeed, only when they happen to be deeply entombed, or lodged in a protecting cave or fissure below the general surface of erosion, are they likely to be preserved Fortunately, in places, the stripping away of the Karroo strata exposed older beds of limestones which, like those of Virginia or the Mammoth

Cave district, dissolve away, leaving caverns that offer a night's shelter to man and beast

Much of this stripping was the work of the Orange River and its tributaries, of which the most important is the Vaal This draws its headwaters from the Eastern Transvaal, so that rain water falling within 160 miles of the Indian Ocean may travel 1000 miles across the width of the continent before entering the Atlantic For 300 miles the Vaal forms the boundary between Orange Free State and the Transvaal, passing within 40 miles of Johannesburg and Krugersdorp before striking southwest to join the Orange River (Fig 1) Above this confluence, when abreast of Kimberley, it is joined by the Harts River which comes in from the north along the edge of Bechuanaland. A branch of this stream, the Dry Harts, flows between the village of Taungs and the edge of the Kaap plateau, an escarpment of Transvaal Dolomite (late pre-Cambrian) in which a quarry was opened by the Northern Lime Company during the first world war

PLATE I View from the original *Australopithecus* site across Norlim kilns to Dry Harts valley

From this Norlim quarry in 1924 came a fossil skull, of which its scientific foster-parent, Dr Raymond Dart, wrote "The specimen is of importance because it exhibits an extinct race of apes intermediate between living anthropoids and man" (3) The head was that of a six-year old, not of a full grown adult But Dart drew attention to the human, rather than ape-like, character of its jaw, teeth, eye-sockets and skull contours Despite these features, however, he was not ready to grant the creature full human status, considering it rather a pre-human type Other eminent anthropologists were less kind, stressing its sub-human aspects and dismissing "Dart's Baby" as more akin to the gorilla or chimpanzee than to Man So for a decade *Australopithecus africanus* Dart—the "southern anthropoid from Africa"—had to bide his time on the shelf

In 1886 gold had been struck on the Witwatersrand—we would have named it the Clearwater Reef—and a string of settlements sprang up overnight on either side of Johannesburg along the outcrop of ore-bearing conglomerate which was to yield 10 billion dollars of the precious metal The following year, one of these mining camps in the West Rand district, 25 miles from Johannesburg, was named after the president, Paul Kruger Today Krugersdorp is a thriving town with sixty miles of tree-lined streets, in the heart of a district which still retains the original names and curiously shaped boundary lines of farmlands granted to the first Dutch settlers Farther south these farm plats are often circular, being the largest area the first owner could ride round and stake out with stone cairns between dawn and sunset

Over the lunch table at Pretoria, a leading lawyer told me that as a boy, when his family still owned the farms of Swartkrans and Kromdraai, six miles from Krugersdorp, he used to play bowls on the attic floor with a "stone skull," one of several that had been picked up in the fields The soil, however, was poor and the Swartkrans farmlands were better known for the Sterkfontein caves in outcrops of the limestone which was worked for the kilns For half a century, fossil bones of antelope, horses, monkeys, baboons, porcupines, and rats have been picked from the rock debris in the caves In 1935 the enterprising author of a tourist guide to the district even advised visitors to "Come to Sterkfontein and find the missing link!" In 1936 Dr Robert Broom did go to Sterkfontein and found the broken skull of *Australopithecus transvaalensis* (4) Later study led him to establish it as a new genus, *Plesianthropus*, though still a member of the same family of Australopithecinae as Dart's original find

In 1938 another australopithecine, *Paranthropus robustus*, was found two miles away at Kromdraai, thanks to a fossil-hunting schoolboy, who had been carrying round in his trousers pocket four precious teeth—"the most wonderful ever seen in history"—on which Broom at once pounced In his book on "the South African Fossil Ape-men," Dr Broom gives a racy account of the events which led up to this and the other finds in the Sterkfontein area, including the way in which he persuaded the school headmaster, in return for a lecture on the importance of caves, to let the boys out early enough for Gert Terbranche, the lad in question, to take him back to the spot before dusk Since then, more has come from both Kromdraai and Sterkfontein (5) In June of the season I was there, a remarkably human-looking pelvis came to light (6), and Dr Broom now has fossil parts representing more than a dozen distinct individuals, some betokened only by their share of the gross of teeth that have been collected In April, 1948, twenty-six pits were excavated by the University of California Expedition at Bolts Farm, a mile from Sterkfontein From two of them australopithecine leg bones were recovered (7) Finally in December, 1948, Dr Broom reported the finding at Sterkfontein of the teeth and massive lower jaw of "Swartkrans Man" (8), apparently a related creature, but of distinctly heavier build

Appropriately named *Paranthropus crassidens* ("coarse-toothed"), with teeth 50 per cent larger than *P robustus*, the creature resembles in this respect the so-called giant types found by von Koenigswald in Java and known also from South China (9) Thanks to enviable public relations in the weekly press, Swartkrans Man has earned the reputation of a giant Actually there is no evidence of great stature The amount of his remains thus far recovered is distinctly limited,—limited in fact to four teeth, firmly embedded in a broken piece of his jaw not over three inches in length This may suffice to let Dr Broom's almost uncanny intuition restore the head (10) But it is a trifle risky to let fancy reconstruct an entire animal on the basis of its out-size dentition, mostly missing The story is told of three agents for competing hair-restorers The first dropped a bottle on his doorstep in the dark, and awoke next day to find a luxuriant fully grown door-mat The second had a tabby which failed to give right-of-way to the lawn-mower, and was converted by caudectomy into a Manx cat, a mishap quickly remedied by the use of his magic hair-restorer The discarded tail was thrown over the hedge "Oh," said the third man, who lived next door, "I found that tail on the grass, and tried some of our famous restorer Next morning we had a new cat" Even if reconstructions of Swartkrans Man prove later to be more accurate than the restored feline, it remains true that we had very little of him to start with

Meanwhile field work had been progressing in Makapansgat valley, 150 miles to the north A limestone cave had long been famous as the last holdout of the fierce native chief Makapan, whose marauding tribe had attacked Dutch settlers and killed their leader Potgieter In revenge, the Dutch, after fierce fighting, drove the natives into the cave, filled the entry with a wall of stones and brushwood, set fire to the latter, and virtually exterminated the warriors within A nearby cave showed signs of earlier occupation, and the Bernard Price Foundation provided funds for a meticulously careful excavation which, in the interval between my first and second visits, yielded Early Paleolithic implements In the report which I was asked to make on the prospects of further success, it needed no great acumen to confirm the well-founded belief of the scientists of the Archaeological Survey directing the work that here, if anywhere, actual fossil remains of the makers of those stone tools should be found *in situ* Still, it was satisfying to learn that two weeks later a jaw of Neanderthal type was blasted out of the travertine I added the hope that excavating would also be resumed in a distinctly older cave deposit, at the limeworks a mile farther down the valley, where Professor Dart and his students had previously found fossil baboon skulls of a species associated with Australopithecines in the southern localities Within a matter of days (September, 1947) Dart reported the finding of an adult australopith occipital bone (11), followed in July, 1948, by an infantile right parietal and an adolescent jaw, and finally last October by a right maxilla and part of the face of a female adult Australopithecine remains have thus been recovered from dolomite caves in three widely separated localities—Taungs, Sterkfontein and vicinity, and Makapansgat—and further field work can hardly avoid uncovering more

PLATE II Original entrance to Cave of Hearths

In the growth of scientific knowledge, the newer finds are often unkindly disconcerting Where only a few data or single specimens exist, an easy explanation may fit all the known facts Incomplete knowledge suggests a spurious simplicity But newer discoveries refuse to fit the theory, and the first hypothesis has to be recast Some of the certainties of the physics and chemistry of fifty years ago have been placed in the discard by a fissionable atom For years French and German anthropologists denied human status to Piltdown Man, if only on the ground that his skull was so thick—a pardonable lapse, perhaps, in view of the fact that he lived in England But when Peking Man appeared in a North China cave, and proved the owner, not only of an equally thick cranium, but of stone implements and a dead fire on the hearth as well, the status of Eoanthropus had to be reconsidered It has been so also with *Australopithecus africanus* Dart

No one questions the claim of the Australopithecinae to accredited membership in the exalted Anthropoid Suborder of Primates to which both men and apes belong There is more hesitation about accepting them into the family of the Hominidae, which includes our noble selves, *Homo*, *sapiens* and otherwise, *Sinanthropus* from Peking, *Pithecanthropus* of Java, and *Eoanthropus* from Piltdown The first point of debate is how many anatomical quality points they had amassed towards graduation into true human status with all rights and privileges appertaining thereto—reading, writing, arithmetic, cannibalism, and atomic destruction The second question is how close they stood to the ancestral stock from which modern man is descended

PLATE III Excavation in progress at entrance to Cave of Hearths

In any attempt to compare the mental ratings or I Q 's of the various primates, the volume and shape of the brain are often useful indicators Account has to be taken, of course, of the body size, age, and sex of the individual, of the relative development of the different brain sectors, and of the extent and complexity of the convolutions which increase the brain surface without adding to its bulk Average cranial capacities for the chimpanzee and gorilla are 400 and 480 cc respectively, with possible extremes of 20 per cent in either direction (Fig 2) In comparison, *Pithecanthropus* of Java is credited with from 750 to 900 cc On this basis of skull fragments of 15 individuals, *Sinanthropus* is allowed 915–1225 cc (average 1040), while *Homo*, ancient and modern, hovers around 1500 cc but may extend as much as 30 per cent in either direction For, while the oft-cited Dean Swift had a headpiece of over 2000 cc and a modern Hottentot in Capetown had one of the same size, Anatole France did very creditable thinking with only 1100, while the great diplomat Leon Gambetta saved France with even less

Thus while the hominid types range from over 2,000 cc down to 750, there has existed an unfilled gap between the smallest brained humans and the highest living apes with 520 cc It is precisely into this "No Man's Land" that the South

African types fall The two *Plesianthropus* skulls held brains of 435 and 560 respectively, as against 650 for *Paranthropus* The *Australopithecus* six-year old had a 520 cc skull, which in view of his premature death is consistent with an adult brain of 700 cc Of course we know neither the range of variation within each species, nor whether these particular samples were of average brain size for their types Schepers points out that if the *Paranthropus* specimen was of average cranial capacity, mere normal variation within the species might well involve a range of from 490 to 815 cc Thus the brains of the australopithecines span the gap between genuine apes and real men On the basis of skull capacity alone, then, their status as fully human remains a moot point

On the second issue, it is clear that no living or recent ape can be the close relative of anything but another ape But going back a million years, the forebears of today's apes and men were less advanced, and perhaps a little closer to each other, as they were nearer to the common ancestor of both lines of descent Possible closeness to human lineage is therefore directly related to other questions—How long is it since the australopithecines were alive? Did they all live at about the same time, or were some of them separated by hundreds of thousands of years? Does a study of the setting in which their remains occur suggest anything as to their nature, habits and environment, which a careful study of fossil material on a laboratory table would not reveal? These are the questions the anthropologist asks the geologist and the paleontologist

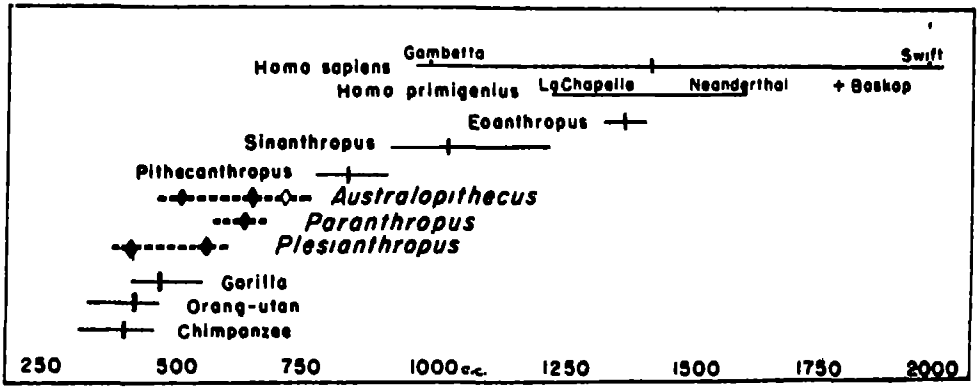

FIG 2 Actual cranial capacities of Australopithecinae compared with averages and ranges for other primates

But first let us approach the anthropologist Unfortunately we seem to find him sitting on the fence—though maybe less assured than he was when Dart faced the scientific world almost single-handed with his back to the wall and his "baby" on his arm Of course, the anthropologist speaks with dogmatic assurance or he wouldn't be a scientist! But maybe I do him an injustice Perhaps it is he who is putting the australopiths on the fence for our inspection And having hardly more knowledge about these matters than had Australopithecus himself, I can only quote what comes out of wiser heads than mine

Dr Weidenreich, to whom we owe the later precise studies of *Sinanthropus pekingensis*, was in no two minds about *Australopithecus* In a paper written in 1948 for the volume commemorating Dr Broom's eightieth year, he admits the human appearance of the dentition and other features but considers that the shape of the brain is simian, and concludes that the puzzling humanlike features these creatures show were holdovers from the past, rather than anticipations of the future "In other words, the features they share with man are those retained from an original stock when they, like typical anthropoids, acquired special differentiation These led them away from the hominids whose differentiations went in other directions" (12) When I spoke with Dr Weidenreich in New York a few days before his death last July, he said he had seen nothing to change this opinion

Professor LeGros Clark of Oxford, dean of British anatomists, takes a less extreme position In New York last June he stated his opinion (i) that the ten skulls of which parts had then been found are all of animals belonging to the same group, (ii) that they show certain features which distinguish them from typical apes (*e g*, the absence of the gap next the incisor teeth which characterizes the latter), (iii) that their original owners were ape-like creatures with some hominid features that are closer to man than to apes, and (iv) that there is nothing in their morphology that would prevent their being ancestral to *Homo sapiens* (13) Others who, at first cautious, are now ready to accept *Australopithecus* as already human include Adloff, Kleinschmidt, Sollas and Von Koenigswald

Homo neanderthalensis
Pithecanthropus erectus
Paranthropus robustus
Plesianthropus transvaalensis
Australopithecus africanus

PLATE IV Blackboard sketches made by Dr Robert Broom at American Museum of Natural History of cranial outlines and facial reconstructions of Australopithecine and higher hominid types

Reference was made to the human appearance of the pelvic bone found by Broom at Sterkfontein I saw it lying on his table between the corresponding bones of a chimpanzee and a modern Zulu woman (6) The resemblance to the latter, and the entirely different proportions of its chimpanzee counterpart, were so glaringly obvious as to be beyond dispute The later finds at Makapansgat led Dart to break up and examine carefully every block of breccia and fragment of bone in the ten tons that had come to the laboratory from the 600 tons on the cave dump—a long task, not yet completed He thus recovered odd teeth, bits of limb bones, a left ilium and a right ischium, which fully confirm the evidence of the Sterkfontein pelvis by proving even more human-like (14) But although these features strengthen the apparent close relationship to modern man, direct descent is another matter For since man was certainly living on the earth by very early in the Pleistocene Period, the australopiths can be the progenitors of modern man only if the Sterkfontein fossils date from the Pliocene Period, unless, indeed, more than one race of men evolved independently in different centres Hence the need to fix the geological age of the breccias on some other basis

Australopithecus himself then, lying silent on the laboratory table beside the other primate skulls, refuses, sphinx-like, to answer the question, and winks at the geologist, who goes discreetly back to his cave to look for clues of other kinds The cave-deposits yield fossil bones of quite a range of other animals If these can be shown to have lived at the same time as Australopithecus, and if their geological age is exactly known, the deposit may be dated Failing these, the character of the cave-filling itself might be linked to climatic changes related to such widespread fluctuations as those which went with the onset and waning of the glacial stages of the Great Ice Age Yet again, the opening up and subsequent filling of the caverns is related to landscape changes—especially those connected with the past history of the rivers, the widening of the valley floors, and the wearing back of the hill slopes If no single approach gives a certain answer, several may combine to set limits to the antiquity of the creatures embedded in the cave-filling

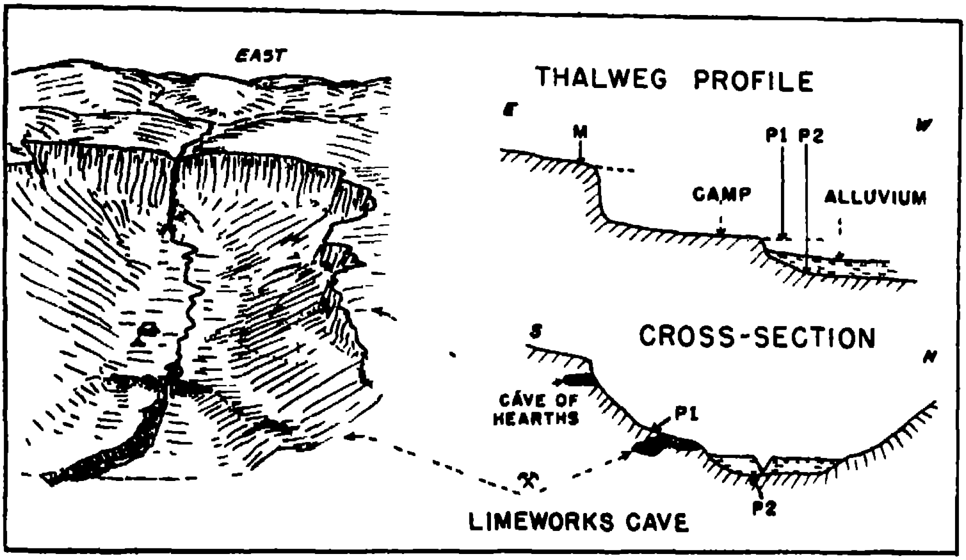

Fig 3 Generalized Physiographic Diagram and projected Profiles of Makapansgat Valley

Showing position of Limeworks and Cave of Hearths relative to erosion surfaces M P1 and P2

The geological age of the fossil-bearing deposits may first be fixed within broad limits and thus clamped, as in the jaws of a vise, between an earlier and a later date As the gap is narrowed, the dating becomes more precise Since neither the creatures nor their fragile remains could get into a fissure or cave before it was opened to the air, they cannot have roamed the land till *after* the limestone was first exposed by erosion But this occurred well before the close of the Tertiary Era, which leaves the lower limit sadly loose and far-extended In the other direction, the bedrock and its cave fillings had been bevelled off to a smooth surface by erosion *before* the streams gained enough fresh energy to incise it again Therefore the cave fillings were already there at least before the penultimate life cycle of the streams Fig 3 shows the sharply discordant relationship between the steep slopes of the Makapansgat valley and the older low-relief surface of the upland it incises The bench bevelling the Limeworks breccia is a remnant of the

P-1 surface which is preserved in the valley head Downstream from the campsite knickpoint, this surface has been almost entirely destroyed by a later erosion cycle (P-2) Since then, the rock-floor of the valley has been buried under a ten-foot cover of alluvium and surface wash, and is only exposed where cut through by recent stream action (Somewhat comparable features may be seen in many of the valleys of southern Ohio, where branches and terraces along the base of the hills provide strips of flat ground, much appreciated by railroad engineers and road builders since they stand well above flood-level when the fields on the valley bottoms go under water But these farm-studded platforms are built of sand and gravel, hastily dropped by glacial meltwater, whereas the occasional tell-tale benches of South Africa had to be sculptured over a much longer time from solid rock) On grounds which range farther afield than we can roam tonight, the final shaping of that lost landscape (P-1) at Makapan can hardly be much younger than Lower Pleistocene [3] Consequently, the cave-fillings must be of greater age

PLATE V Camp Dart and Haughton, in Makapansgat Valley

Even this still leaves the time gap unhappily wide Further field studies will undoubtedly cut it down

Meanwhile the cave-deposits themselves throw further light on the problem Whereas with surface sediment dropped by rivers the top layer is more recent than what lies below, any visitor to Mammoth Cave finds a whole network of galleries at different levels, connected by vertical chimneys or sloping chutes A fissure extending to the surface may fill with debris, funneled down from above almost as soon as it is breached A roofed cavern may fill more slowly, partly with stalagmites and wall coatings left by evaporating limewater dripping from the ceiling, partly with sand and silt washed in by underground streams, and partly with fallen roof rock As the roof collapses, both floor and ceiling are raised, and the cavity migrates upwards Once filled, a cave site may be partially reopened by solution and even refilled a second time Thus two caves in a single locality may have quite different histories In Locality 1 at the Peking Man site, the infilled material was over 180 feet in depth and represented three distinct epochs of accumulation One zone 25 feet deep formed an indivisible unit, all deposited in a brief space of time Another just above it, only 17 feet thick, had 100 separate layers,—black, red and yellow from the hearth-fires of repeated human occupation Caves and their contents are therefore capricious things, often guilty of deceitful underground behavior which may mislead the unwary

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[3] Several factors conspire to make close dating of the Pre-Pleistocene erosional surfaces in South Africa peculiarly difficult Almost the only Tertiary datum level of any extent is that set by the Alexandria Limestone and its equivalents along the south-east coast, which have a marine fauna allied to that of Miocene-Pliocene age in Europe Surfaces related to this and other Tertiary raised beach levels are hard to trace, (1) because prolonged uninterrupted denudation has destroyed the older landforms over wide areas, (2) because profiles run into the interior have to be carried over immense distances over varied structures which make the use of knickpoints and kindred tell tale features unreliable as criteria of rejuvenation, and (3) because the attention to development of natural resources has left little margin of time and energy for geomorphic studies on the part of the competent but small group of qualified geologists available in so vast a region

Unlike the other Australopithecine sites, the classic Taungs locality was not a cave The fossils occur in a pink breccia of rock fragments choking fissures in an immense platform of travertine This platform was built out in irregular sheafs of fluted curtains, festoons and cauliflower-like growths, round the outlets of long-dead springs in a notch of a Transvaal dolomite escarpment at the edge of the Kaap Plateau (Plate I) Animals that came to drink and lost their footing, or died on the slopes above, were washed into open crevasses and pockets, along with sand, gravel, and coarser rock debris In time, the spreading growth of travertine had advanced 1200 feet from its earliest position Enough accumulated to keep the battery of Norlim lime-kilns running full blast for two decades Hence its period of growth must have spanned some tens of thousands of years The individual breccia-pockets are sometimes roughly layered but, except that the lower rear parts of the deposit are older than the front upper parts, the structure offers little on which to base a stratigraphic sequence However, its upper surface is pitted with solution pockets choked with red-brown earth, obviously dating from a later epoch of different conditions This brown earth is criss-crossed with white veins of calcite, and sometimes contains late Paleolithic stone implements and even layers of ash, charcoal, and burnt bones Right on the surface we picked up dozens of small stone flakes, identified by Dr van Riet Lowe as belonging to the Smithfield and Wilton microlithic cultures, corresponding to Aurignacian and Magdalenian types of the later Old Stone Age of Europe

Six months of excavation (1947–1948) by the University of California Expedition at some 30 sites along the edge of the Kaap plateau on either side of Taungs produced no new australopithecine material but had other results of importance In many places the pink breccias yielded fossils of his contemporaries, including baboon skulls of types found at Sterkfontein and Makapan And at a number of sites, beneath the pink breccia, Dr Camp's party found an older grey breccia, with remains of horse and antelope, invariably *sans* baboons (15) Along the face of the escarpment there are open caves of still younger date, some with Middle Stone Age implements sealed in the floor where Man dropped them, others with even more recent artifacts showing Bushman techniques But until the fossils from the two breccias have been studied and compared with those from other sites, we can say only that as far as Taungs is concerned the pink Australopithecus-breccia is distinctly *younger* than the moister days with horse and antelope of the gray breccia, and considerably *older* than the brown earth pockets of late Pleistocene days when human culture had already advanced through several stages

In the Krugersdorp district and at Makapan we are dealing not with surface crevasses and pockets in spring deposits, but with true cavities in bedrock The rock at the Sterkfontein, Kromdraai and Bolts Farm sites is Transvaal Dolomite, essentially the same formation as at Taungs At Sterkfontein, the caves follow two main fissure systems which run north down the dip of the strata In the spot where *Plesianthropus* was first found, the character and position of the material now occupying what once was a cave argue against its having been used as a lair by animals The filling is mainly of boulders and rock fragments of all sizes in a matrix of terracotta sand, well cemented with lime Much of the rock debris had been weathered above ground level before falling into the hole along with blocks of roof-rock No stratification can be detected, though the lower part of the mass is on the whole coarser and freer from fossils, while broken bones become increasingly abundant in the upper, finer portion of the breccia. This distinction between a lower and an upper zone is seldom abrupt, but follows an inclined surface, as if the whole mass involved successive slumping on the side of a heap or talus It is probable, therefore, that, except for rodents, bats, and other small cave-dwellers, the fossil material, like the bulk of the deposit, was funneled down from the surface

For caves to form, moisture is necessary But climates fluctuate In places, the breccia is separated from the bedrock by a pavement or wall-coating of travertine Further, according to Cooke (16), the sandy matrix of the breccia has much less chert and quartz in proportion to carbonate than exists in the soil on the hill slopes today This suggests that the climate when the cave was filling was *drier* than that of today, thus leaving a greater percentage of dolomite unleached in the soil than occurs under present conditions.

PLATE VI Dolomite caves in Makapansgat Valley

This is the same sequence of climatic fluctuations as was noted at Taungs, where the formation of the pink breccias was both preceded and followed by conditions of greater moisture Haughton has pointed out that the observed facts call only for (a) a moist period to account for cave and fissure solution, (b) a semi-arid epoch to explain the angular dolomite fragments with weathered crusts, and the red sandy matrix, (c) a period of renewed moisture to cement these into travertine, and (d) the period of renewed erosion which bevelled the bedrock and incised the valley of the Vaal and its tributaries (17) (This generalization refers to the climatic fluctuations during the critical interval between formation of the cavities and the time when the fossiliferous breccia choking them suffered the same surface reduction that affected the entire region Haughton was concerned neither with the earlier erosional stages which first exposed the limestone, nor with the clearly marked episodes which punctured the later history of the drainage system of the area.)

It would of course be highly significant if the inferred sequence of climatic fluctuations could be shown to tally with more widespread changes such as those which caused the successive advances and retreats of the Pleistocene ice-front in Europe Though East Africa has several volcanic peaks within a degree of the Equator with active glaciers on their flanks today, there was no Great Ice Age in South Africa But the arid stage in the wet-dry-wet sequence must have swept an increased volume of sand and loess into the lee sector Bosazza believes he can identify four distinct invasions of desert conditions during and since the Pliocene, one of these being attested by a mantle of red sand and loess along the Harts near Taungs (18) But though the stages of Alpine ice advance have been correlated with climatic and sea-level changes recorded well outside the glaciated areas on both sides of the Mediterranean, we still know too little as to just how closely these tally with events further from the ice centers One might argue that each epoch of renewed erosion in, say, the Kharga Oasis of Egypt meant heavier rainfall, and that these correspond exactly with the times when, in more northerly latitudes, increased precipitation brought the snow which became the ice But the climatic controls governing the spread of ice conditions are still too poorly understood for it to be safe to equate pluvial conditions in Kenya with glacial stages in the Alps, still less to link the spread of the Kalahari desert with inter-pluvial or interglacial stages on the other side of the Equator

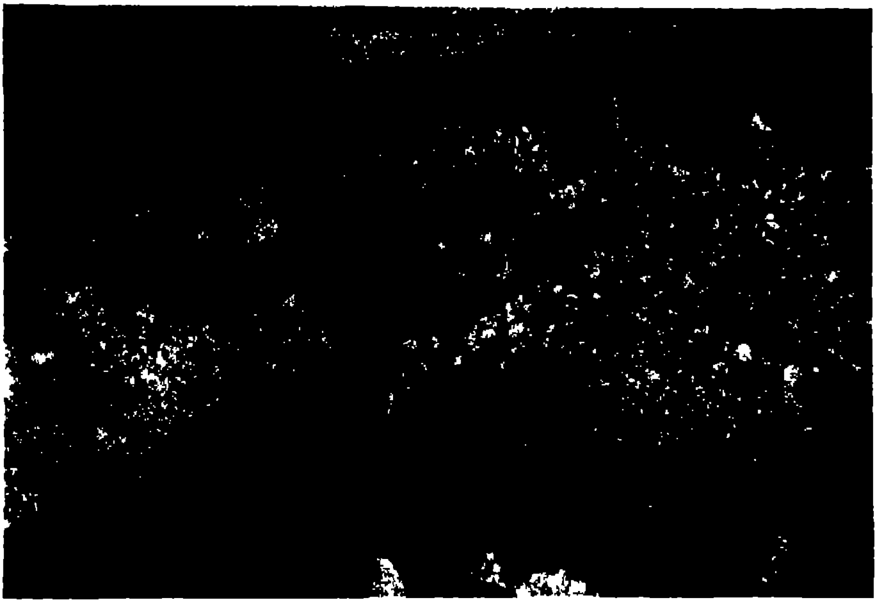

PLATE VII Excavation at Sterkfontein site

The growth of the Pleistocene ice-caps withdrew from the ocean enough cubic miles of water to lower sea-level on every coast around the globe With each such marine retreat, rivers had to entrench their channels, first at their mouths, and then progressively upstream But shifts of standline may result also from purely local disturbances of the Earth's crust And until these have been ruled out as a possible cause, we dare not assume that any particular ancient sea-beach, standing today at, say, 600 feet above sea-level, records the highwater mark of a particular interglacial stage Correlation is made harder by the fact that in any case most of the older beaches have been warped from their pristine horizontal position The S E coast of Africa has excellent raised beach lines and progress is being made in unravelling these frayed edges of the record But as yet it has not been extended back to the time when Australopithecus was alive

So thus far neither inferred fluctuations of climate, nor sea-level shifts traced by knickpoints up the rivers, give criteria of the definiteness needed to fix the particular geological dates in question

There remains the paleontologist's line of attack—that of correlating animal fossils found in the australopithecine breccias with their dated equivalents elsewhere The faunal assemblages at the Taungs, Makapan and Krugersdorp sites all belong to the same general epoch of geological history But like the slightly younger Peking Man fauna, they occur in an isolated region, far from the nearest place where precise age-determinations have been possible Furthermore, the assemblages at the various sites show differences greater than can be explained by immediate environment or mere chance It is clear, as might be expected, that they are not strictly contemporaneous, and represent a span of time measurable perhaps in thousands of years, if not more Thus Sterkfontein has yielded—to mention only a few types by their common names—sabre-tooth tiger, roan antelope, reed-buck, wildebeest, a small jackal, several species of baboon, golden mole, elephant-shrew, rats and other rodents Bolts Farm produced a host of mammals, including the same shrew as at Sterkfontein, but a larger golden mole, a different sabre-tooth, besides fossil pig, a single elephant tooth which may prove significant, and other types not as yet found elsewhere Kromdraai on the other hand has some of the same animals, but lacks both sabre-tooth and pig, while its baboons are of a different species from those at Sterkfontein On this account, Broom considers *Paranthropus* from Kromdraai to be geologically slightly younger than *Plesianthropus* From Makapan, Dart reports two species of baboon found also at Sterkfontein, lion, hyena and jackal, two extinct pigs, rhinoceros, hippopotamus, two extinct relatives of the giraffe, and fourteen types of *Bovidae*, eight of them new to science None of the Taungs creatures were forest dwellers, several being definitely desert forms Both Makapan and Taungs have types not found at Sterkfontein or Bolts Farm, but there is enough in common for the four sites to be regarded as of approximately the same geologic age The assemblage as a whole shows affinities with the Villafranchian fauna of Northern Italy

PLATE VIII Quarry face at Norlim Limeworks, showing dark pockets of fossiliferous breccia

A single discrepant element is the presence at Sterkfontein of *Lycyaena silbergi*, a hyena-like animal closely resembling one found in the Lower Pliocene of Europe and Asia Until further study has established a more certain affinity, it is unwise to place too much weight on this single animal, which may, after all, have lived on in Africa long after his European and Asiatic cousins had become extinct

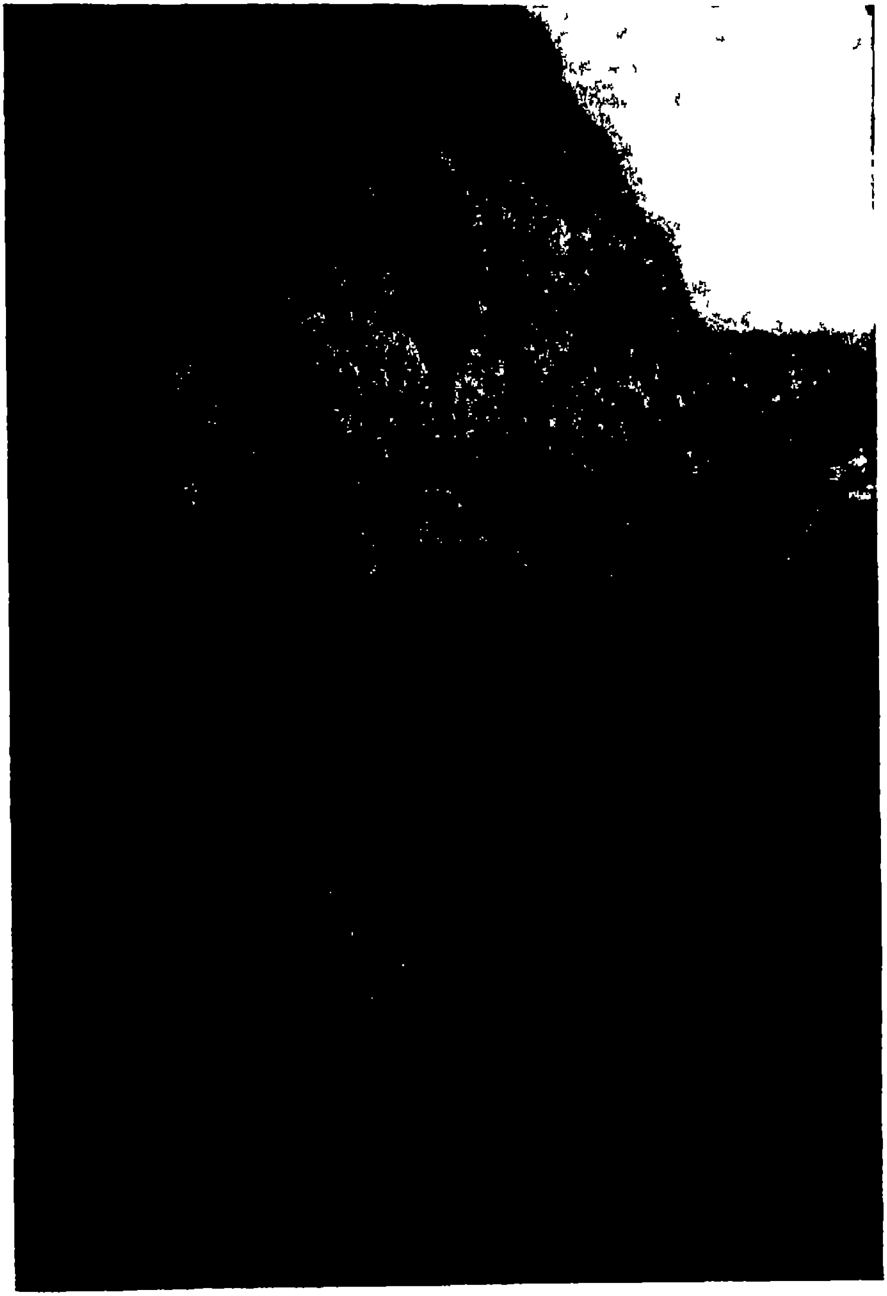

PLATE IX Fossil hunting in blasted rocks at Taungs site

Stratigraphic opinion is divided as to the exact place of the Villafranchian with respect to the Plio-Pleistocene boundary,—depending on whether the latter is to be set by the first symptoms, the main onset or the approach to culmination of the first glacial advance, the shift of sea-level, or the resulting changes in fauna, marine or terrestrial The question was thought worthy of a special section in the XVIII International Geological Congress last summer in London, where a mass of evidence was presented in favor of various period-markers Some authorities have placed both the Villafranchian and the succeeding Calabrian epochs in the Pleistocene Others would have the boundary separate the two As far as the Eastern Hemisphere is concerned, the most satisfactory solution is that of Gignoux which leaves both in the Pliocene, a conclusion supported by Pilgrim (19) on the basis of faunal assemblages in Europe and Asia Zeuner (20) has attempted to correlate the arguments from this and other lines of evidence Using the latest data of Milankovitch (21) on climatic fluctuations, he places the lower boundary of the Pleistocene 600,000 years ago American geologists favor a somewhat earlier date for the dawn of the Great Ice Age on this continent And yet, maybe the exact hour of dawn is more a matter of local point of view than a source of concern to Australopithecus himself, for on any reckoning, he seems to have been living a full million years ago

We have looked at our extinct friends from a wide variety of angles—namely, those of the anatomist, anthropologist, geologist, physiographer, stratigrapher and paleontologist, and perhaps are left with the feeling that nothing has been achieved except to shed a flood of inspissated darkness on a cloud of confusing uncertainties Yet the evidence from these various lines of approach seems to be closing in on the figure of a primitive human, barely emerging from his anthropoid background, who stepped out from the shadows into the sun on the South African veld about the time when the ice sheets were starting to push down across Canada and Northern Europe Each new piece of evidence from whatever source has to be fitted into the new jigsaw puzzle Thus *Australopithecus prometheus* was given his second name because microscopic and chemical study of apparently burnt animal bones strongly suggested the use of fire—as proved the case with Peking Man Some have criticized Dart for leaving out the question-mark he originally placed before the word "(?) Promethean" (11) What matter a few specks of carbon black? And yet one other curious feature was noted by Dart (22) long before the recent discoveries A high proportion of the fossil baboon skulls had been crushed in, as if by a severe blow, carefully aimed from the front Admittedly an occasional ape might have walked in a cave exactly where a piece of roof-rock was about to fall on his cranium But it was hard to account for the number of cracked skulls assembled on Dart's laboratory table from different localities several with the same peculiar double-dent trade mark, as if struck with the leg-bone of an ox or some other large animal It seemed no easier when Dr Peabody found the same condition in half a dozen more baboon skulls unearthed at Taungs Careful study showed that 42 out of 58 crania of *Parapapio* from the three *Australopithecus* sites showed the same feature The blows struck were deliberate and meant to kill Furthermore, the blows not aimed straight from the front were preponderantly struck at the left side of the head, as if by a right-handed individual! (25) Granted a verdict, not of "death by misadventure," but of "baboonicide," there is of course the question that was raised in the parallel case of "Humanity v Peking Man"—Is it possible that Australopithecus, like Sinanthropus, could try to plead "Not guilty," by blaming some other higher primate who shaped the crude stone tools we found in the cave at Choukoutien, but who was clever enough to hide his own skeleton? All one can say is that as yet there is no evidence pointing in that direction, even Swartkrans Man being an Australopithecine himself

The fractured adolescent mandible from Makapansgat (23) corroborated previous evidence (24) that the Australopithecinae not only were carnivorous hunters of large and small game, but were cannibalistic and killed one another with stones, wooden clubs or bone bludgeons An account of lethal injuries inflicted upon the crania of baboons found at Taungs, Sterkfontein and Makapansgat has recently been published by Dart (25) A letter just received from him adds that the Makapan breccia has now also yielded evidence of a bone and horn culture, little, if at all, different from that which l'Abbe H Breuil claimed as characteristic of Peking Man

Presidential addresses possess one great advantage, alike for the pride of the perpetrator and for the comfort of his long-suffering audience—for like the motion to adjourn, they are not debatable

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THE HELMINTHS FROM A HEAVILY PARASITIZED FOX SQUIRREL, SCIURIS NIGER

PAUL D HARWOOD AND VIRGIL COOKE,
Ashland, Ohio

Usually tree squirrels harbor relatively few helminths per individual but as shown by Rausch and Tiner (1948), the variety of parasites which may be encountered in these hosts is considerable Generally the fox squirrels which the senior author has examined from this community have been negative for helminths, however, an adult female, which was shot near Ashland on September 27, 1943, was an exception

One immature specimen of *Macracanthorhynchus hirudinaceus* (Pallas, 1781) was found in the body cavity It was attached to the inside left flank, and the tissues about the site of attachment were necrotic

Two female *Rictularia*, possibly *R onychomis* Chuckler, 1939 were removed from the small intestine The tails of these ♀ ♀ were shorter than those described by Chuckler In view of the questionable specific diagnosis the following brief description is given Length, 40 mm , combs and spines, prevulvar 29 and 31, postvulvar 31 and 32 Vulva 0 15 mm cephalic to end of esophagus, esophagus 4 9 mm long nerve ring at 0 39 mm from cephalic extremity Stoma 0 087 mm deep and 0 09 mm wide, tail 0 25 mm long Eggs 39 μ by 24 μ

Eight *Moniliformis clarki* (Ward, 1917) were taken from the small intestine One of these, a female specimen, was 35 5 cm long and weighed (wet) 2 2 grams

Twelve tapeworms were found in the same habitat as the thornyheads These appear to represent a new species which is described as follows

Choanotaenia sciuricola n sp

The strobilae measured up to 30 cm when fully relaxed and before fixation After preparation for microscopic examination a specimen measured 25 5 cm long and 2 64 mm wide The scolex is 0 26 mm long and 0 32 mm wide at the level of the unarmed suckers which are 112 by 78 μ The rostellum is 71 9 μ wide and 184 3 μ long Twenty-two rostellar hooks are arranged in a single crown They are very slender and 38 μ long, the handle being 24 μ and the blade 14 μ long

The long distinct neck is 0 123 mm wide The segments are at first wider than long, but the mature segments are about as wide as long They measure about 1 6 by 1 9 mm The genital pores are irregularly alternate and are located near the cephalic margin of the proglottid The cirrus pouch is small and slender measuring 150 to 130 μ by 31 to 38 μ It extends mesad, in extreme cases, as far as the excretory vessel but usually falls short of that structure Only one pair of excretory ducts, apparently the ventral pair, could be distinguished either in sectioned or entire material The cirrus is unarmed The vas deferens serves as a seminal vesicle The testes, which are confined to the caudal portion of the proglottid are 29 to 41 μ in diameter In 49 segments the number of tests varied from 27 to 37, mean 31 1, standard deviation 2 2 One segment, not considered in the above mean, contained 43 testes The ovary is small, indistinctly bilobed and placed about the middle of the proglottid The vagina runs caudal to the cirrus pouch and the coiled vas deferens Near the middle of its course is an enlargement which serves as a seminal receptacle The uterus extends cephalad of the ovary at first It is thin walled and soon breaks down

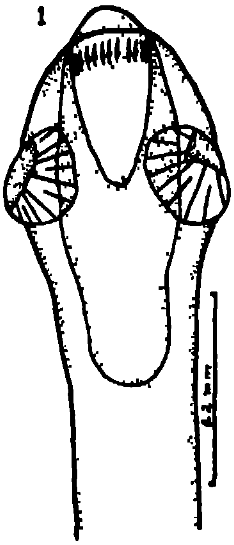
The gravid proglottids are much longer than wide The eggs are scattered singly throughout the areolar parenchyma The embryonic hooks are 18 5 μ long, the embryo is 54 7 μ in diameter and the eggs are 59 by 68 5 μ

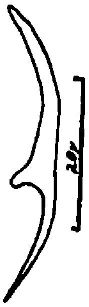
Locality Ashland, Ohio, September 27, 1943
Host *Sciurus niger*
Habitat Intestine

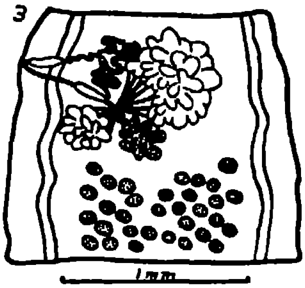
Specimens Type U S National Museum, Helm Col No 46406 Additional material in the author's collections

Comparisons *Choanotaenia sciuricola* agrees with the generic diagnosis given by Fuhrman (1932) except for the absence of the dorsal pair of excretory vessels Therefore this tapeworm is referred tentatively to the above genus although similar worms from rodents have been referred heretofore to other genera of questionable validity

Choanotaenia is a large genus, but fortunately 39 of the species are easily distinguished from *C sciuricola* by the number of the hooks on the rostellum The remainder are compared below *C iola* Linicome 1939, *C scolopacis* Joyeux and Baer, 1939, *C meliphagidarum* Johnston, 1911, *C taylori* Johnston, 1912, and *C unicoronata* (Fuhrman, 1908) all have fewer than 26 testes On the other hand *C marchali* (Mola, 1907) and *C tringae* Joyeux and Baer, 1937 have more numerous testes (50 to 60) In *C magnihamata* Burt, 1940 the handle of the rostellar hooks is only one-half as long as the blade The hooks of *C macracantha* (Fuhrman, 1907) are extraordinarily long (110 to 148 μ)







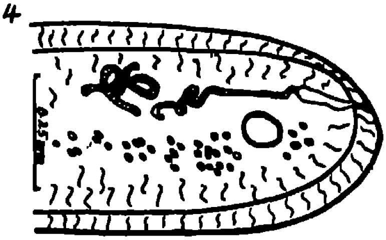


FIG 1 Scolex of *Choanotaenia sciuricola* FIG 2 Hook from rostellum of *C sciuricola* FIG 3 Mature segment of *C sciuricola* FIG 4 Cross section at level of cirrus pouch

C sciuricola resembles *Prochoanotaenia peromysci* Erickson, 1938 more closely than other forms described heretofore The rostellar hooks are longer in *Choanotaenia sciuricola* (38 μ against 32 μ) although the scolices are about the same size The strobilae of the present species are much larger, and the testes are more numerous On the other hand the cirrus pouch is much smaller in *C sciuricola*

Discussion Unfortunately the senior author has not recorded the results of every fox squirrel which he has examined, consequently, the incidence of parasitism in the animals examined cannot be given exactly, but only one out of 8 to 12 squirrels was found infected with any helminth

The occurrence of *Macracanthorhynchus hirundinaceus* in a fox squirrel from Ashland County seems peculiar since the parasite is rare in swine raised in this area

However, the parasite has been reported previously from this host by Rausch and Tiner (1948)

The same writers report finding a *Rictularia* sp in two of 94 fox squirrels examined by them and Katz found the same parasite in one of 16 fox squirrels which he examined All were from western Ohio

Rausch and Tiner (1948) state that *Moniliformis clarki* is uncommon in midwestern sciurids, but Chandler (1947) reports it from other areas Contrary to Rausch and Tiner, this parasite may be common in the fox squirrels of Ashland County, since hunters have brought this large worm to us for identification on several occasions However, in animals which have been completely examined for helminths, we have found it only once

Two squirrels were shot at the edge of the same corn field on September 27 One, an adult female, was heavily parasitized, and weighed 740 grams, the other, an immature female, weighed 710 grams, although obviously much smaller The tail of the immature, unparasitized female was two inches shorter than that organ in the adult When the 23 helminths had been collected from the adult female, they weighed in the fresh state just 30 grams Therefore, the adult squirrel, though of larger body, weighed no more than the helminth-free, young female

The adult female was shot at 4.30 P M , the immature at 5·00 P M At 8·00 P M , after both squirrels had been dressed and examined, it was noted that rigor mortis was pronounced in the carcass of the young animal, but that of the adult was still flabby Since helminths parasitic in domestic animals upset the carbohydrate metabolism of their hosts, this observation may possibly be of some significance

SUMMARY

Four species of helminths were found in a fox squirrel, *Sciurus niger*, shot near Ashland, Ohio One of these, *Choanotaenia sciuricola*, represents a new species

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A Textbook of Entomology

The author of this book departs somewhat from the usual presentation of information for the general or beginning entomology textbook Chapters on growth and history of the development of entomology and paleontology have been added as well as a separate chapter on physiology The keys to order and family are not intended to be all inclusive and therefore will accommodate only the common members of the more important families of insects The content of the book is as follows, by chapters Growth of North American Entomology Arthropoda Insects and Their Allies, External Anatamy, Internal Anatomy Physiology, Life Cycles Orders of Insects, Geological History, Ecology, and Control Selected references are given at the end of each chapter and also for each order of insects

The book is well illustrated with many new figures It is an excellent addition to our growing list of general entomology textbooks and undoubtedly will be widely adopted for use by many colleges and universities —*R H Davidson*

A Textbook of Entomology, by H H Ross John Wiley and Sons, Inc , New York 532 pages, 434 figures, 1948 $6 00

THIONYLDIACETIC ACID[1]

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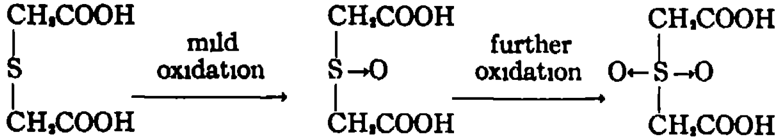
INTRODUCTION

Thionyldiacetic (thionydiglycolic) acid can be classified as a sulfoxide, being derived from thiodiacetic acid by mild oxidation of the sulfur atom present Stronger oxidation or continued oxidation produces the more stable sulfone The relationship existing among these compounds can be shown as follows



$$\begin{matrix}CH_2COOH\\ |\\ S\\ |\\ CH_2COOH\end{matrix} \xrightarrow[\text{oxidation}]{\text{mild}} \begin{matrix}CH_2COOH\\ |\\ S\rightarrow O\\ |\\ CH_2COOH\end{matrix} \xrightarrow[\text{oxidation}]{\text{further}} \begin{matrix}CH_2COOH\\ |\\ O\leftarrow S\rightarrow O\\ |\\ CH_2COOH\end{matrix}$$

thiodiacetic acid thionyldiacetic acid sulfonyldiacetic acid

In 1909, Gazdar and Smiles (1) prepared thionyldiacetic acid by dissolving thiodiacetic acid in excess hydrogen peroxide (concentration not stated) and allowing the solution to stand at room temperature for forty-eight hours, followed by evaporation of excess water The sirupy residue became solid, they state, on being kept under diminished pressure over sulfuric acid Their product, which was "evidently pure," melted at 79–80° C An analysis for carbon and hydrogen agreed reasonably well with the theoretical value but neither a sulfur analysis nor an equivalent weight determination were reported In 1923, Jonsson (2) prepared this compound in a similar manner, though he dissolved the thio acid in acetone prior to addition of 30% aqueous hydrogen peroxide in excess After an evaporation in vacuo, the crystalline mass was washed free of impurities with ethyl ether His product melted at 119° C Finally, Larsson (3) reported, in 1940, that he obtained thionyldiacetic acid by the oxidation of thiodiacetic acid using bromide water His yield was low and the product melted at 109° C It is evident from these conflicting records that the identity of thionyldiacetic acid cannot be considered as definitely established This investigation was undertaken to evaluate various methods that had been reported for its preparation and to study its physical and chemical properties It appears likely that the lack of agreement in the literature regarding this compound resulted, at least in part, from its unstable nature, and therefore all possible precautions were taken to insure a minimum amount of decomposition

METHODS OF PREPARATION

Literature references relative to the preparation of sulfoxides indicate that they are most conveniently obtained by mild oxidation of the corresponding sulfides In general, 30% hydrogen peroxide has given excellent results (4), although other oxidizing agents including nitric acid, chromic acid, potassium permanganate, the halogens and perbenzoic acid have been successfully used In this paper, investigation has been limited to the oxidizing effect of hydrogen peroxide, nitric acid and potassium permanganate upon thiodiacetic acid

The studies of Gazdar and Smiles and of Jonsson were repeated first, since in both instances the favored reagent, hydrogen peroxide, had been used A 25-gram sample of freshly prepared thiodiacetic acid was dissolved in 30 ml of 30% hydrogen peroxide and the solution allowed to stand for 48 hours at room temperature

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[1] Presented at the meeting of the Ohio Academy of Science, Toledo, Ohio on May 7, 1948

[2] Presented as a thesis in partial fulfillment of the requirements for the Master of Science degree

Evaporation in vacuo over sulfuric acid yielded 3 grams of solid product, slightly yellow in color and melting at 100–105° C Upon washing the product with small amounts of ice-cold acetone, it became pure white and melted sharply at 119° C (corr) with decomposition A quantitative analysis yielded 19 37% sulfur (calculated value for thionyldiacetic acid, 19 29%) and an equivalent weight determination was found to deviate less than 1% from the calculated value of 83 1 for the desired dibasic acid The yield, using this procedure, was only 11% of theoretical, and it was noted that considerable heat evolved when acid and peroxide were mixed Moreover the yellow solid showed the presence of rather large amounts of sulfate ion as an impurity

Repetition of the above procedure except for cooling of the reaction flask in crushed ice as the reactants were mixed, yielded 7 5 grams (27% yield) of white product melting at 119° C and showing only traces of sulfate ion Several more trial runs were made in order to note the effect of varying several conditions such as the solvent used for the reaction, the optimum length of reaction time, the optimum concentration of hydrogen peroxide and the solvent most suitable for washing the product One series of experiments in which the reactants were permitted to stand for time intervals up to 30 days indicated that oxidation was virtually complete in 48 hours and, in fact, yields began to decrease after 10 days standing It is worthy of mention that the only instance in which there was the slightest evidence for the formation of a substance, such as Gazdar and Smiles reported as melting at 79–80° C , occurred following a 30-day reaction time between thiodiacetic acid and 30% hydrogen peroxide A small amount of a white solid was obtained following the usual in vacuo evaporation It was insoluble in water but soluble in acetone and, upon recrystallization from that solvent, melted at 79–80° C It was extremely unstable above its melting point, exploding with considerable violence A qualitative examination indicated the absence of sulfur and of acid properties This compound was not identified though its properties were indicative of a labile organic peroxide

As a result of these experimental data, we recommend the following procedure for the preparation of thionyldiacetic acid Dissolve 20 grams of thiodiacetic acid in 60 ml of warm water in a 200 ml erlenmeyer flask Cool in an ice-water bath and add slowly 25 ml of 30% hydrogen peroxide After the addition is complete, stopper the flask loosely and allow the solution to stand in the cold bath for one hour with occasional agitation by hand and then for 48 hours at room temperature in the dark Following this period of time pour the solution into an evaporation dish and place in a vacuum desiccator over sulfuric acid Evacuate and permit evaporation to proceed to dryness The sulfuric acid may become dark brown but this does not affect the product Approximately 30 hours is required for this step The solid residue is washed with small portions of dry ethyl ether, then air-dried The amount of product should range from 15 to 16 grams representing a 70% yield The product is white, melts at 119° C (corr) with decomposition and gives no test for chloride or sulfate ion

While the foregoing experiments were in progress, a study of the oxidizing action of nitric acid on thiodiacetic acid was begun Beckman (5) had reported the preparation of diisoamyl sulfoxide from the sulfide, using fuming nitric acid and Gazdar and Smiles (1) repeated this preparation and found the product to be identical with that obtained from a hydrogen peroxide oxidation In this investigation, portions of thiodiacetic acid were treated with nitric acid in varying concentration In trial 1, using fuming nitric acid a vigorous reaction occurred with considerable evolution of heat even when the reaction flask was immersed in an ice-water bath After the reaction subsided, the reactants were allowed to stand for 48 hours at room temperature This was followed by in vacuo evaporation to dryness. The residue so obtained was white and quite water-soluble Both its equivalent weight and its melting point (177–181° C) suggested that sulfonyldiacetic acid (m p 182° C) was the main product However, the yield was low and it is unlikely that any but traces of thionyldiacetic acid could, if formed, withstand the high reaction temperature noted in the early stages of the experiment Virtually identical results were obtained in trial 2, using concentrated nitric acid and similar reaction conditions, though the yield of sulfonyldiacetic acid was slightly higher A third trial, with 8N acid, evolved much less heat and was easily controlled Again the yield was increased but only the sulfone, contaminated with the original thio acid in some quantity, appeared to form In trials 4 and 5, using 4N and 1N nitric acid respectively, thiodiacetic acid was recovered unchanged The problem of utilizing sufficiently concentrated acid to promote oxidation of sulfide to sulfoxide without concurrent heat production sufficient to destroy any thionyldiacetic acid which might form, and without concurrent production of considerable amounts of sulfone, was not resolved

Potassium permanganate has been used in numerous instances to oxidize sulfides to sulfoxides and sulfones Sulfonyldiacetic acid has been prepared from the thio acid by several investigators, the most recent modification having been reported by Alden and Houston (6) in 1932 Attempts on our part, however, to use permanganate for the production of the intermediate thionyl acid have been unsuccessful

In some instances the halogens have been used to convert sulfides to higher oxidation products Earlier mention has been made of Larsson's report (3) that he had made thionyldiacetic acid (m p 109° C) by the action of bromine water on the thio acid Jonsson (2) records that thionyldiacetic acid and bromine react to produce tetrabromodimethyl sulfoxide (m p 52–53° C) and tetrabromodimethyl sulfone (m p 161° C) Oddy and Dietz (7) have found that when thiodiacetic acid in dilute water solution is treated with bromine an insoluble white solid slowly precipitates out After recrystallization, it melts at 160–161° C and analysis indicates that it is tetrabromodimethyl sulfone This is a confirmation of Jonsson's report They have found, further, that if thiodiacetic acid is allowed to react with bromine in absolute methyl alcohol solution a product can be isolated which melts at 113 5–115 5° C and which, according to their analytical data, is tetrabromodimethyl sulfide In view of these results and of the confirmation given Jonsson's preparation of thionyldiacetic acid by the experimental data in this paper, it is doubtful if the product described by Larsson was thionyldiacetic acid at all The instability of both thio and thionyl acids in the presence of bromine leads us to believe that his preparation might have been a mixture of these tetrabromo derivatives described above No experimental work on the oxidizing action of the halogens on thiodiacetic acid was undertaken in this investigation

PHYSICAL AND CHEMICAL PROPERTIES

Thionyldiacetic acid is a white solid, very soluble in water, ethyl alcohol, and dioxane It is moderately soluble in acetone and practically insoluble in ethyl ether, petroleum ether and carbon tetrachloride When pure it melts sharply at 119° C (corr with decomposition

X-ray diffraction patterns of powder samples of both thiodiacetic and thionyldiacetic acids were made and the relative intensities of the lines $\left(\frac{I}{I_0}\right)$ and the interplanar distances (dÅ) were computed These data are presented in Table I The line intensities were determined by visual comparison with a photographic grey scale

The most marked chemical property of this acid is its instability Upon standing at room temperature it slowly changes to a light yellow color A 10-gram sample which was set aside for 60 days was found to be almost totally decomposed at the end of that time Five-gram samples were heated at various temperatures for 2 hours and, after heating, equivalent weight determinations were made The results are given in Table II

In water solution at temperatures above 50° C, the thionyl acid is relatively unstable as it is in cold mineral acid solutions In hot acid solutions the breakdown is very rapid Decomposition also occurs under diminished pressure When placed in vacuo over sulfuric acid, at room temperature, the product yellows rapidly and the sulfuric acid becomes light brown in color

TABLE I

X RAY DIFFRACTION PATTERN MEASUREMENTS OF THIODIACETIC ACID AND THIONYLDIACETIC ACID

THIODIACETIC ACID		THIONYLDIACETIC ACID	
$\frac{I}{I_0}$	dÅ	$\frac{I}{I_0}$	dÅ
0 1	4 410	0 2	9 117
1 0	3 958	0 2	4 641
0 15	3 670	1 0	4 069
0 9	3 334	0 15	3 948
0 4	2 938	0 5	3 780
0 5	2 763	0 15	3 528
0 4	2 653	0 2	2 908
0 8	2 437	0 3	2 728
0 1	2 312	0 2	2 568
0 3	2 204	0 25	2 363
0 25	2 018	0 25	2 281
0 55	1 665	0 15	2 169
0 55	1 502	0 15	1 812

TABLE II

EFFECT OF ELEVATED TEMPERATURES UPON THE STABILITY OF THIONYLDIACETIC ACID

TEMPERATURE	TIME OF HEATING	EQUIVALENT WEIGHT (Theor Value 83 1)	COLOR OF ACID AFTER HEATING
40° C	2 hrs	83 5	White
60° C	2 hrs	83 4	Light Yellow
80° C	2 hrs	83 0	Light Yellow
100° C	2 hrs	82 1	Yellow
120° C	2 hrs	78 3	Dark Brown Gummy Mass on Cooling

DERIVATIVES

(a) *Salts*

A rather comprehensive investigation of the insoluble salts of thionyldiacetic acid was made Aqueous solution of the acid was added to solutions of some eighteen common metallic ions Heavy insoluble precipitates were obtained with Ag^+, Pb^{++}, Hg^{++}, and Ba^{++} A small amount of white precipitate formed with Sr^{++} and a small amount of a dark brown precipitate was obtained with Cu^{++} In general, these insoluble salts were found to be much more stable than the free acid

The white barium salt is sparingly soluble in hot water but rapidly dissolves, with decomposition, in hot hydrochloric acid It crystallizes from water with two molecules of water of hydration

The silver salt is difficultly soluble in hot water but very soluble in hot nitric acid Quantitative analysis of the air-dried salt indicates no water of hydration The salt is bright yellow in color when freshly precipitated but slowly darkens upon exposure to air and light

Lead acetate solution precipitates a white salt insoluble in both hot and cold water but soluble in hot hydrochloric and nitric acids A quantitative analysis yielded 55 7% lead (calc 55 8% Pb)

A white insoluble mercuric salt is formed with mercuric nitrate solution It is insoluble in hot and cold water but dissolves in hot hydrochloric acid Analysis yields 55 1% mercury (calc 55 0% Hg)

The precipitates formed with strontium and copper ions were not further investigated

(*b*) *Esters*

Attempts on our part to prepare esters by direct esterification of thionyldiacetic acid with alcohol were unsuccessful Jonsson reported that he had made the ethyl ester of the thionyl acid by oxidizing diethyl thiodiacetate with 30% hydrogen peroxide but he gave no data concerning his product We used this method of preparing the methyl and ethyl esters with some success

Ten grams of diethyl thiodiacetate was dissolved in 10 ml of glacial acetic acid and 9 ml of 30% hydrogen peroxide was added The solution was allowed to stand for 48 hours then evaporated in vacuo over sulfuric acid for another 48-hour period The residual liquid was dissolved in ethyl ether and partially reprecipitated with petroleum ether After washing with water, the liquid was again dried in vacuo for 12 hours The product had a foul odor and undoubtedly was somewhat contaminated but it could not be further purified without decomposition occurring A quantitative analysis produced 14 3% sulfur and the product was assumed to be diethyl thionyldiacetate (calc 14 5% S) The following physical characteristics were determined boiling point, 160° C (22 mm) with decomposition, density, d_{25}^{25} 1 112, refractive index, n_D^{25} 1 1667

Dimethyl thionyldiacetate was prepared in a similar manner and the following physical characteristics determined boiling point, 105–107° C (22 mm) with decomposition, density, d_{25}^{25} 1 331, refractive index, n_D^{25} 1 4805

SUMMARY

1 A study has been made of methods for the oxidation of thiodiacetic acid to thionyldiacetic acid and a modified procedure for the preparation of the latter has been recommended

2 A number of physical and chemical properties of thionyldiacetic acid have been noted

3 Several salts and two esters of thionyldiacetic acid have been described

Acknowledgment is gratefully made for the assistance given us by Mr Bernard Steierman in the x-ray diffraction studies described in this paper

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SOME ASPECTS OF THE DISTRIBUTION OF LARVAL PARASITES OF THE ORIENTAL FRUIT MOTH IN OHIO

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The Ohio Agricultural Experiment Station has carried on investigations with the oriental fruit moth, *Grapholitha molesta* (Busck), since 1925 During this time collections of fruit moth larvae have been made at frequent intervals each year to determine the extent of larval parasitism The purpose of this paper is to present an interpretation of the data collected over the sixteen-year period from 1932 to 1947

Neiswander (1936) last published a list of parasites reared from the larvae of the fruit moth in Ohio The list below includes the 1936 list plus species collected since that time Only hymenopterous species are included, some of these are possible secondary parasites

Apanteles aristoteliae Vier
A clavatus (Prov)
A epinotiae Vier
Ascogaster quadridentatus Wesm
Atrometus clavipes (Davis)
Bassus cinctus (Cress)
B diversus Mues
Calliephialtes grapholithae (Cress)
Campoplex tortricidus Cush
C validus Cress
Coccygomimus aequalis (Prov)
Cremastus carpocapsae Cush
C epagoges Cush
C forbesi Weed
C minor Cush
C tortricidis Cush
Dibrachys boucheanus (Ratz)
D cavus (Walk)
Eubadizon pleuralis Cress
Euderus subopaca (Gahan)
Eupelmus amicus Gir
Gambrus ultimus (Cress)
Gelis tenellus (Say)
Glypta rufiscutellaris Cress
G vulgaris Cress [3]
Goniozus columbianus Ash
Hemiteles mellicornis Ash
Horogenes molestae (Uchida)
H obliteratus (Cress)
Itoplectis conquisitor (Say)
Macrocentrus ancylivorus Rowh
M delicatus Cress
M instabilis Mues
M pallisteri DeGant
Mastrus pilifrons (Prov)
Meterorus trachynotus Vier
Microbracon politiventris (Cush)
Microgaster ecdytolophae Mues
Perilampus fulvicornis Ash
Phaeogenes walshiae walshiae Ash
Pristomerus ocellatus Cush
Psychophagus omnivorus (Walk)
Scambus hispae (Harris)
S pterophori (Ash)[3]
Spilochalcis torvina (Cress)
Trichomma reticulatum Davis
Trichogramma minuta Riley

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[1] The author is indebted to the many workers of the Ohio Agricultural Experiment Station who contributed to the collection of the data Particular acknowledgment should be made to R B Neiswander and R W Rings of the local station as well as to N D Blackburn, now at Pennsylvania State College, for making the data available to the author

[2] In co-operation with the Division of Fruit Insect Investigations, Bureau of Entomology and Plant Quarantine

[3] *Glypta vulgaris* (Townes 1944) and *Scambus pterophori* (Balduf 1929) have not been reared from oriental fruit moth larvae in Ohio but do occur in Ohio and are parasites of the pest elsewhere

Of this list, seven are of major importance Their percentage occurrence is listed below

Macrocentrus ancylivorus	60 0% of parasites
M delicatus	19 3% " "
Glypta rufiscutellaris	7 5% " "
Cremastus minor	5 8% " "
Pristomerus ocellatus	2 1% " "
Horogenes obliteratus	1 4% " "
Ascogaster quadridentatus	0 3% " "
Others	3 6% " "

These figures are computed from totals of 81,573 insects reared from collections made in 17 counties and 154 orchards, 39,331 of these insects (48 2%) were parasites

The percent of parasitism through the entire state is of interest however, the sampling did not take place in such a way that equal numbers were collected from each portion of the state It will be noted that parasites occurred in different ratios in different sections For these reasons the calculation of percentages of parasitization from the total number of insects collected does not reveal the true picture Accordingly, for these investigations, the state has been divided into three portions and the average percent of parasitization of these three sections has been computed for each year The results are shown in Table 1

TABLE I

PERCENT PARASITIZATION OF ORIENTAL FRUIT MOTH LARVAE BY ALL PARASITES BY SECTIONS—1932-1947

YEAR	NORTH	CENTRAL	SOUTH	AVERAGE
1932	47 3	27 6	20 6	31 8
1933	44 8	37 4	67 6	49 9
1934	46 0	43 6	22 9	37 5
1935	80 2	46 7	47 4	58 1
1936	66 3	37 0	30 5	44 6
1937	48 1	44 4	20 7	37 9
1938	73 1	55 4	46 8	58 4
1939	62 6	38 7	42 7	48 0
1940	50 4	42 9	18 3	37 2
1941	52 2	31 3	35 3	39 6
1942	40 4	67 5	32 3	46 7
1943	38 7	54 3	29 7*	40 9*
1944	47 3	44 8	27 0*	39 7*
1945	47 4	31 1	24 4*	34 3*
1946	58 9	37 7	21 7*	39 4*
1947	44 8	37 2	19 1	33 9
Mean	53 0	42 4	31 7	42 4

*These are estimates since no data are available from southern orchards during these years To obtain these estimated values a straight line has been drawn between the 1942 and 1947 percents of parasitization and indicated values on that line used

On a state wide basis commercial control of the oriental fruit moth by means of parasites has not been achieved In isolated areas and on occasional years, control has been satisfactory but the parasite population over the state as a whole remained too low to give good results in spite of large releases of adult parasites

No trends in percent of parasitization can be noted Total parasitization has not increased but has remained at a fairly constant level It will be shown that *M ancylivorus* has increased in numbers and therefore has done so at the expense of other parasites instead of contributing to higher levels of parasitization of the host pest

Since the two species of *Macrocentrus* are the most important parasites in the state and account for the majority of the parasitized fruit moth larvae, their relative proportions have been computed Counties in which the ratio of *M ancylivorus* to *M delicatus* was high include Sandusky, Summit, Lorain, Ottawa, and Cuyahoga, these are in the northern portion of the state In the central region a medium ratio was found, counties studied in this region were Knox, Mahoning, Columbiana, Franklin, Wayne, and Licking Belmont, Hamilton, Butler, and Lawrence comprise the southern counties in which a low ratio was found That is, the ratio between the two species was high in the north and decreased to the south Total parasitization of oriental fruit moth larvae showed the same type distribution

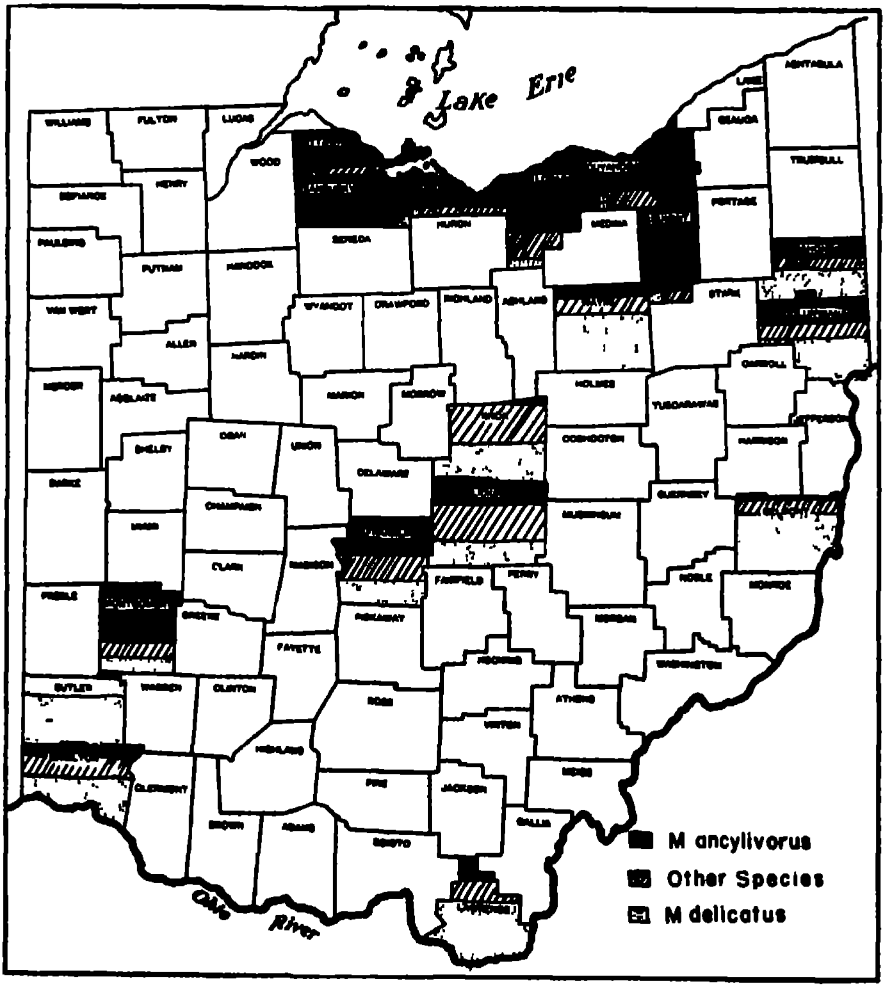

FIG 1 Relative occurrence of *Macrocentrus* spp and other parasites of the oriental fruit moth in Ohio (Percents of county area in black stippled, and cross barred, represent the percents of the respective species collected from that county)

Of the counties studied one important exception is made Montgomery County which is geographically located in the southern section is omitted Here the occurrence of *M ancylivorus* has been predominant, probably because of the presence of extensive plantings of strawberries that supported a large strawberry leaf-roller (*Ancylis comptana fragariae* (W & R)) population and consequently a high *M ancylivorus* population

The nature of the distribution of these two species in the state is shown on the map in Figure 1 Solid black portions show the percent of *M ancylivorus*, stippled areas represent the percent of *M delicatus*, cross-barred areas show the percent of other parasites Counties without markings are not represented in this report Inspection of the map will show that in counties in the southern section the predominant species was *M delicatus*, while in northern counties it was *M ancylivorus* In the central section counties the parasitism was more or less evenly divided between the two species

TABLE II

PROPORTIONS OF *M ancylivorus* TO *M delicatus* BY GEOGRAPHCIAL SECTIONS FOR THE YEARS 1932–1947

	NORTH		CENTRAL		SOUTH	
	M anc	M del	M anc	M del	M anc	M del
1932	96	4	31	69	1	99
1933	82	18	4	96	1	99
1934	89*	11	16	84	1	99
1935	99	1	37	63	1	99
1936	99	1	3	97	8	92
1937	99	1	9	91	0	100
1938	99*	1	22*	78	1	99
1939	96*	4	10*	90	1*	99
1940	97*	3	35*	65	33*	67
1941	99*	1	55*	45	43*	57
1942	95*	5	27*	73	64*	36
1943	94*	6	32*	68	no record	
1944	94*	6	57*	43		
1945	96*	4	67*	33		
1946	99*	1	92*	8		
1947	93*	7	66*	44	56	44

*Indicates that releases of more than 400 adult *M ancylivorus* were made in the area for the year

The author attempted several correlations of the relative abundance of the two *Macrocentrus* species with various climatic phenomena None of the factors investigated presented a pattern that would account for the distribution of the species Inadequacy of weather data in studies of this type makes any conclusions impossible

The relative proportion of *M ancylivorus* to *M delicatus* is shown in Table II

The conclusions from the table are obvious In the northern section, *M ancylivorus* clearly predominated In the central section, *M delicatus* predominated for the first nine years and *M ancylivorus* has shown the lead in five of the past seven and four of the last four years Prior to 1942 *M delicatus* was dominant in the southern regions but *M ancylivorus* has shown an increase since 1940 and in the last two years of record (1942 and 1947) has made up more than fifty percent of the total of the two species It is well known that in cases of multiple parasitism *M delicatus* usually suffers in competition with *M ancylivorus*

In northern Ohio, Neiswander (1936) has shown that releases of adult *M ancylivorus* in Ottawa County established the species and contributed to a high parasitization of fruit moth populations The significance of the increase of *M ancylivorus* in southern Ohio in the year 1940 has not been determined. It appears, however, that parasite liberations were a contributing factor in the accumulation and perpetuation of the species in the south although there is no statistical correlation between the numbers of *M ancylivorus* released and the numbers of this parasite recovered

It is probable that *M ancylivorus* was not indigenous to Ohio If not, there is the possibility that after 15 years of the presence of the oriental fruit moth the species was yet in the process of becoming established and the release of adults was necessary to achieve success After establishment it could build up its numbers without additional assistance The fact that from 1942 to 1947 in the southern section there were no releases, yet the species continued at a high level, lends weight to this argument

The conclusion that *M ancylivorus* is increasing in relation to *M delicatus* may be made from the above data It now becomes desirable to investigate the relation of *M ancylivorus* to the oriental fruit moth population Table 3 shows this relationship

TABLE III

PERCENT OF FRUIT MOTH LARVAE PARASITIZED BY *Macrocentrus ancylivorus*

	NORTH	CENTRAL	SOUTH
1932	18 0	1 6	1 0
1933	17 4	1 3	0 0
1934	26 3	6 7	1 0
1935	73 9	13 3	0 0
1936	58 7	1 0	2 2
1937	44 1	3 0	0 0
1938	53 4	8 4	1 0
1939	46 9	3 3	1 0
1940	30 0	14 9	5 7
1941	33 0	15 9	14 0
1942	24 7	15 7	14 4
1943	30 1	16 1	no record
1944	34 8	24 8	
1945	41 3	16 7	
1946	50 5	30 4	
1947	40 4	23 6	10 3
Average	39 5	12 3	4 2
Slope*	+ 32	+ 1 66	+ 1 58

*Indicates the slope of a straight line fitted through the points and indicates the rise in percent per year

The slopes of the three lines cannot be demonstrated to be statistically significant for the entire group of years In the south and central sections, however, since 1940 the rise has been sharp, indicating that *M ancylivorus* is parasitizing a larger percentage of larvae than in the past

Since *M ancylivorus* is parasitizing a larger number of larvae it might be concluded that it is bringing about better control of the oriental fruit moth However, in view of the fact that the percent of parasitism is not increasing in any section of the state and *M ancylivorus* is competing with *M delicatus*, it must be maintained that *M ancylivorus* is increasing at the expense of other parasites and not at the expense of the fruit moth The desirability of this condition is open to question

SUMMARY

Macrocentrus ancylivorous, *M delicatus*, *Glypta rufiscutellaris*, and *Cremastus minor* are the most important parasites of the oriental fruit moth in Ohio The first two species accounted for 60 0 and 19 3 percent, respectively, of the larval parasitization of the fruit moth over a 16 year period (1932–1947) The average percent of fruit moth larvae parasitized by all parasites during this period was 42 4% Percent of parasitization showed no upward trend over the period

The state is divided roughly into three geographical sections on the basis of relative occurrence of *M ancylivorus* and *M delicatus* The former is high in the northern section with the proportion decreasing from the north to the south The percent of total parasitism exhibits the same relationship, high parasitization occurs in the north and decreases from north to south The proportion of *M ancylivorus* to other parasites is very high in the northern section and has been on the increase in the central and southern sections since 1940 Releases of adult *M ancylivorus* are probably partially responsible for this increase The percent of larvae parasitized by *M ancylivorus* is also increasing slowly in the northern area, more rapidly in the central and southern sections *M ancylivorus* is achieving its increase at the expense of other parasites rather than contributing to the increased destruction of the host insect

LITERATURE CITED

Balduf, W V 1929 Bionomic Notes on Some Parasites of *Achatodes zeae* Harris and *Phylectaenia tertialis* Guen Ohio Jour Sci 29 218–242

Neiswander, R. B 1936 Oriental Fruit Moth Investigations in Ohio II Ohio Agr Exp Sta Bull 569 1–30

Townes, H K. 1944 Catalogue and Reclassification of the Nearctic Ichneumonidae Memoirs of Amer Ent Soc No 11 Parts 1 and 2

WILDLIFE FACTS

The National Wildlife Federation estimates that the yield of commercial fish can be increased by over forty per cent in a few years through the use of conservation practices

Approximately one hundred and thirty different species of fish are captured commercially in waters adjacent to the United States and Alaska reports the National Wildlife Federation

Gigantic lizards, says the National Wildlife Federation, were the motives for many of the legends of winged dragons and griffins consequently, their modern descendants are the subject of superstition and fear

The heaviest flying bird in America, says the National Wildlife Federation, is the trumpeter swan with a maximum weight of forty pounds.

Sixty six species of birds are enemies of the cotton boll weevil reports the National Wildlife Federation Among these are the Bobwhite Quail, Red headed Woodpecker, Bluejay, and the Oriole

Twenty four birds help control the chinch bug, reports the National Wildlife Federation, an insect pest that does great damage to wheat Among these birds are the Meadowlark, the Flicker, and the House Wren

The National Wildlife Federation requests you not to pick or dig wild flowers unless they are abundant

To birds must go the credit for being a vital factor in checking the hoards of injurious insects, weed seeds and small rodents, reports the National Wildlife Federation Without birds, agriculture would be next to impossible

ANNUAL REPORT OF THE OHIO ACADEMY OF SCIENCE
1949

Organized 1891 Incorporated 1892
Affiliated with the American Association for the Advancement of Science

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OFFICERS AND COMMITTEES FOR 1949–1950

President
Paul B Sears

Vice-Presidents

A *Zoology* W F Hahnert
B *Plant Science* J F Stanfield
C *Geology* R J Bernhagen
D *Medical Sciences* I D Puppel
E *Psychology* A G Bills
F *Physics and Astronomy* M L Pool
G *Geography* C M Wilson
H *Chemistry* R G Bossert
I *Mathematics* L P Cummins
J *Science Education* H C Hulme
K *Anthropology* F L Utley

Secretary
Rush Elliott

Treasurer
R M Geist

Historian
William H Alexander

COMMITTEES

Executive Committee

Ex-Officio Paul B Sears Rush Elliott R M Geist
Elective G B Barbour G W Blaydes

Membership

A *Zoology* G D Morgan, Chairman
B *Plant Science* C C Allison
C *Geology* J O Fuller
D *Medical Science* C A Angerer
E *Psychology* C O Mathews
F *Physics and Astronomy* H V Knorr
G *Geography* H F Raup
H *Chemistry* G L Orr
I *Mathematics*
J *Science Education* Harley Ellinger
K *Anthropology* Kurt H Wolff

Nominating

Vice Presidents of 1948–1949 E T Bodenberg Chairman

Program

Vice Presidents of Sections and Secretary

Library

Miss Lillian Michaelis, Chairman
Librarian in charge of Academy Exchanges and Publications

R A Hefner	Term expires 1951
W M Tidd	Term expires 1953

Publications

Secretary, Chairman

R A Hefner	Term expires 1951
W M Tidd	Term expires 1953

Conservation

C A Dambach, Chairman	Term expires 1950
R V Bangham	Term expires 1950
R W Franks	Term expires 1950
E S Thomas	Term expires 1951
P B Sears	Term expires 1951
Frank J Wright	Term expires 1951
James R Beck	Term expires 1952
R A Hefner	Term expires 1952
E L Rice	Term expires 1952

Necrology

J E Carman, Chairman	Term expires 1950
Carl Ver Steeg	Term expires 1951
H H M Bowman	Term expires 1952

Resolutions

P B Sears	Term expires 1950
W C Beaver Chairman	Term expires 1951
H R Eggleston	Term expires 1952

Trustees of Research Fund

E Lucy Braun	Term expires 1950
Herbert O Osborn	Term expires 1952
E N Transeau, Chairman	Term expires 1951

Academy Representatives

1 On the Joint Administrative Board of the Ohio Journal of Science

R A Hefner	Term expires in 1951
W M Tidd	Term expires in 1953

2 On the Council of the A A A S G W Blaydes

3 On the Save-Outdoor-Ohio Council R W Franks

The Council for 1949–1950

Allison, C C
Angerer, C A
Barbour, G B
Bernhagen, R J
Bills, A G
Blaydes, G W
Bossert, R G
Cummins, L P
Dambach, C A
Ellinger, Harley
Elliott, Rush
Fuller, C O
Geist R M
Hahnert, W F
Heffner, R A
Hulme, H C
Lindsey, A W
Knorr, H V
Mathews, C O
Michaelis, Lillian
Morgan, G D
Osborn, Herbert
Orr, G L
Pool M L
Popham, R A
Puffel, I D
Raup, H F
Sears, P B
Stanfield, J F
Tidd, W M
Utley, F L
Wilson, C M
Wolff, Kurt H

REPORT OF THE FIFTY-EIGHTH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

The Academy met for the second time in this decade on the campus of Denison University on April 21, 22, 23 The Executive and Council meetings were held on April 21 and sectional meetings on April 22, 23 The local committee, under the chairmanship of Dr A W Lindsey, had made excellent arrangements, the attendance was above average and programs were presented by all sections

The first Annual Science Day for the Junior Academy under the reorganized plan was held on April 22, and this was an extremely successful program The entire Junior Academy program is growing rapidly The annual banquet and business meeting was held at the Granville Inn on Friday evening at 6.30 Dr A W Lindsey served as toastmaster Greetings were extended by Dean C F Richards of Denison University, and response was given by Dr H H M Bowman The presidential address was given by Dr George B Barbour on the title, "Ape or Man? The Recent Discoveries in South Africa "

The annual report of the Secretary contained another milestone in the history of the Academy Two hundred and twelve persons were elected to membership in the Academy, the largest number in any single year, and the total membership has passed the 1 000 mark for the first time

The following persons were elected as fellows of the Academy

James A Bright
Floyd J Brinley
E R Bryant
Harold U Cope
William P Cross
James W Cummins
Harley Ellinger
Daniel L Friedberg
Richard P Goldthwait
Harold C Hulme
Arne V Hunninen
George A Kelly
Eleanor Longbrake
Joseph T Maddox
John H Melvin
Ralph B Neiswander
Grover L Orr
Earl E Sanderson
George S Sperti
Elizabeth K Weisburger
Curtis M Wilson
Kurt H Wolff

The report of the Nominating Committee was presented by Dr Ralph A Dexter, of the Necrology Committee by Dr J E Carman, and of the Resolutions Committee by Dr W C Kraatz

Respectfully submitted,

Rush Elliott, *Secretary*

REPORT OF THE EXECUTIVE COMMITTEE AND COUNCIL

The Executive Committee met on December 3, 1948 and again on April 21, 1949, and the Council on December 4, 1948, and again on April 21, 1949

A special committee (R L Edwards, chairman, F H Krecker, G W Blaydes, W M Tidd and James Vaughn) appointed to study the allocation of funds of the Academy presented a report at the winter council meeting The report was accepted and the committee discharged Since the report did not cover some of the current problems, another committee (Eugene Van Cleef, chairman, F H Krecker and A W Lindsey) was appointed to consider methods of increasing the income of the Academy and the allocation of the funds collected This committee made a very exhaustive report at the April meeting of the Council, and a number of recommendations were made which will require amendments to the constitution These are to be prepared for consideration by the Council in 1949–1950

The Executive Committee received the resignation of W M Tidd as Treasurer and appointed R M Geist to complete the year He was elected as Treasurer on the recommendation of the Nominating Committee

The Council approved the election to Honorary Life Membership of E L Rice and Frank J Wright

The Council approved a number of recommendations presented by F H Krecker for the Junior Academy program

The 1950 annual meeting is to be held on the campus of Capital University on April 27, 28, 29, as a part of the centennial program of the University

Respectfully submitted,
RUSH ELLIOTT, *Secretary*

REPORT OF THE TREASURER

COLUMBUS, OHIO, April 21 1949

To the Ohio Academy of Science

I submit herewith a financial statement of the condition of the Ohio Academy of Science as of December 31 1948 The books have been audited and the opinion of the auditor is herewith attached

Respectfully submitted,
R M GEIST, *Treasurer*

OHIO ACADEMY OF SCIENCE BALANCE SHEET
As at December 31, 1948

ASSETS			
CURRENT EXPENSE FUND			
Cash in Bank			$ 489 62
Bonds owned			
U S War Savings Bond—Series F (Cost)		$ 111 00	
U S War Savings Bond—Series G (Cost)		1 900 00	
Total Bonds Owned			2,011 00
Total Assets—Current Expense Fund			$2 500 62
RESEARCH FUND			
Cash in Bank		$ 239 11	
Bonds Owned			
Fort Hayes Hotel, Columbus Ohio (Cost)	$1 300 00		
U S War Savings Bond—Series G (Cost)	300 00		
Total Bonds Owned		1 600 00	
Banc Ohio Securities Stock		437 50	
Total Assets—Research Fund			2 276 61
Total Assets			$4 777 23
LIABILITIES AND NET WORTH			
CURRENT EXPENSE			
Deferred Credits			
1949 Dues collected in 1948			$ 107 50
NET WORTH			
Ohio Academy of Science			
Current Expense Fund		$2,393 12	
Research Fund		2,276 61	
Total Net Worth			4 669 73
Total Liabilities and Net Worth			$4,777 23

OHIO ACADEMY OF SCIENCE STATEMENT OF INCOME AND EXPENSE
For the Year Ended December 31, 1948

CURRENT EXPENSE FUND

INCOME			
Dues from Members			$1 982 50
Grants for Research			156 25
Sale of Publications			10 00
Interest on Bonds			47 50
Total Income			$2,196 25
EXPENSES			
Operating—			
Subscriptions—Ohio Journal of Science		$1 147 50	
Printing Proceedings 1948		174 25	
Printing—other		276 40	
Honorarium—secretary		150 00	
Postage and Office Expense		226 61	
Bank Charges		15 59	
Clerical and Auditing		50 00	
Total Operating		$2 040 35	
Science Education Section—			
Postage and Office Expense	$20 16		
Printing	30 00		
Total Science Education Section		50 16	
Non Operating Expense—			
A A A S Research—Special Grant		156 25	
Total Expenses			2 246 76
Excess of Expenses Over Income			$ 50 51

RESEARCH FUND

INCOME		
Gifts for Research		$72 00
Interest		18 75
Total Income		$90 75
EXPENSES		
Grants for Research	$97 97	
Bank Charges	98	
Total Expenses		98 95
Excess of Expenses Over Income		$ 8 20

AUDITOR S CERTIFICATE

COLUMBUS, OHIO, April 1, 1949

To the Ohio Academy of Science Columbus Ohio

GENTLEMEN

In accordance with your instructions I have examined the accounts and records of the Ohio Academy of Science for the year ended December 31, 1948

A detailed audit was made of all transactions handled by the treasurer Cash in the bank was verified by bank certification Securities in safety deposit box were verified by personal examination My examination was made in accordance with generally accepted auditing standards

In my opinion, the accompanying balance sheet and the statement of income and expense (cash basis) fairly represents the financial position at December 31, 1948, and the results of operations on a cash basis for the year ending December 31, 1948 These statements are in conformity with generally accepted accounting principles

Respectfully yours,
D M SHONTING,
Certified Public Accountant

REPORT OF THE TRUSTEES OF THE RESEARCH FUND

Your trustees present herewith a report of the grants made from the A A A S and the Academy for the year 1948

As there had been no requests except a small one granted to Mr Wood, the Chairman addressed a letter to other Trustees and to a few members who might know of worthy projects, stating that it was desirable at least to have applications to cover the allotment from the A A A S As a result he received some applications which, when approved by the Trustees, were assigned as follows

To Mr Ralph H Bond for study of microscopic fossils, conodonts in shale formations, $156 25 from the A A A S grant

To Mr Joe R Stratton of The University of Toledo for securing and maintaining guinea pigs for experimental work, $48 00

To Dr Ralph W Dexter of Kent State University for studies on distribution of the Fairy Shrimp, $25 00

The grant to Mr Richard D Wood for plates to illustrate an article in the *Ohio Journal of Science* was $26 80

We may repeat the notice that we may expect some $150 00 or more from the A A A S for 1949 and that our Academy fund now $264 70, will permit other grants for desirable studies

Respectfully submitted,
E LUCY BRAUN,
EDGAR N TRANSEAU,
HERBERT OSBORN, *Chairman*

REPORT OF THE LIBRARY COMMITTEE

With a great amount of help from the Treasurer of the Academy, and the co-operation of each member contacted the mailing list of the *Ohio Journal of Science* has been coded to show whether the recipient is a member, a subscriber, or on exchange

There are now 356 exchanges, slightly fewer than when last reported

In 1948 the sale of *special* papers amounted to ten dollars, which amount has been given the Treasurer of the Academy

Respectfully submitted,
LILLIAN MICHAELIS

REPORT OF THE JOINT ADMINISTRATIVE BOARD OF THE OHIO JOURNAL OF SCIENCE

The annual meeting of the Joint Administrative Board of the *Ohio Journal of Science* was held in Columbus, Ohio, April 9, 1949 The meeting was called to order by the Board Chairman, Dr Spieker Present were Drs Meyer and Spieker representing the Ohio State University, Dr Hefner representing the Academy, and Drs Blaydes and Miller representing the *Ohio Journal of Science* Dr Anderson, an Academy representative, was unable to be in attendance Dr Spieker was nominated by Dr Meyer to continue as Chairman The motion was seconded by Dr Hefner Dr Miller continued to serve as secretary of the Board

The minutes of the preceding meeting were read and approved The Chairman called for the report of the Business Manager Dr Miller's report was largely in the form of a financial statement for Volume 48 of the *Journal* A copy of the financial statement is attached to this report Dr Hefner moved the acceptance of the financial statements as read, seconded by Dr Meyer The motion carried

In commenting on the financial picture Dr Miller called attention to the net loss in assets for the fiscal year of $294 65, the operating balance on hand having been reduced from $533 52 at the beginning of the fiscal year to $238 87 at the close of business February 23, 1949 This difference is not due entirely to increased production costs Volume 47 of the *Journal* cost $3038 53 and Volume 48 cost $3088 94, an increase of only $50 41 The real difference is between the $817 66 collected in 1947 as authors' payment of publication costs as compared with $123 50 collected in 1948

Dr Miller also reported that during the year, in co-operation with the treasurer and librarian of the Academy suitable keys were added to the filing and mailing stencils, thus facilitating easy recognization of members, subscribers and exchanges

Dr Hefner moved the acceptance of the Business Managers report, seconded by Dr Meyer, and passed

The Chairman then called for the Editor's report Dr Blaydes presented a review of papers in Volume 48 Briefly, Volume 48 consisted of 252 pages, consisting of 39 papers from 11 science areas Four book reviews were also printed There are 17 manuscripts on hand Following the Editor's formal report the Board discussed the procedure in reviewing manuscripts The Board concurred in the accepted procedure of submitting each manuscript to the Review Board The report of the Editor was accepted on a motion by Dr Meyer, seconded by Dr Hefner

The Chairman called for an election of Editor and Business Manager for Volume 49 Dr Hefner moved the appointment of Dr Blaydes as Editor for Volume 49 The motion was seconded by Dr Meyer Dr Blaydes was unanimously elected as Editor of Volume 49 Dr Miller then presented his resignation as Business Manager of the *Journal* and Secretary of the Joint Administrative Board Dr Meyer moved the acceptance of Dr Miller s resignation, seconded by Dr Hefner and passed by the Board

Dr Spieker then presented to the Board the task of nominating and selecting Dr Miller s successor In the discussion which followed mention of an assistant editor was introduced as being pertinent, Dr Blaydes having indicated his desire to be relieved of the editorship in the near future

Dr Hefner presented the following motions, which were seconded by Dr Spieker first, Dr Meyer and Dr Miller be appointed with authority to interview and select from the list recommended by the Board, a new business manager, second Dr Spieker and Dr Blaydes be appointed with authority to interview and select, from the list recommended by the Board, an assistant editor Both motions were individually acted upon and passed by the Board

Dr Hefner moved, seconded by Dr Meyer, that the Auditing Committee composed of Drs Spieker and Meyer be retained and authorized to proceed with the auditing of the *Journal* business Passed

Dr Spieker reported to the Board that Dr Blaydes and himself called upon President Bevis of Ohio State University and requested that the University s stipend be increased from $1000 00 to $1500 00 per year Dr Spieker is awaiting the reply to this request

Dr Blaydes, as editor of the *Journal*, once again asked that the section Vice Presidents of the Academy be on the alert during their programs for papers suitable for *Journal* publication The Editor requests that such titles and authors be referred directly to him by section Vice Presidents

There being no further business the Board was adjourned on a motion by Dr Meyer seconded by Dr Hefner

Respectfully submitted
JOHN A MILLER
Secretary of the Board

THE OHIO JOURNAL OF SCIENCE

Fiscal Year 1948

RECEIPTS	
Balance from 1947	$ 533 52
University Allowance	1,000 00
Ohio Academy of Science—pro rata of dues	1 140 00
Ohio Academy of Science—proceedings	174 25
Subscriptions	145 00
Sale of back numbers	16 70
Author s payment for plates	194 84
Payment by authors and institutions of publication costs	123 50
	$3 327 81
EXPENDITURES	
Spahr and Glenn, Printing—Vol 48	$2 594 24
Spahr and Glenn, Manilla Envelopes	63 55
Bucher Engraving Company	242 61
Postmaster	150 11
Bank Charges	1 68
Refund	1 50
Clerical Assistance	32 25
Labor	3 00
	$3 088 94
Balance on hand, Feb 23 1949 (Huntington National Bank, Columbus Ohio)	$ 238 87

REPORT OF THE COMMITTEE ON CONSERVATION

Your Committee on Conservation offers the following report for the consideration and approval of the Ohio Academy of Science

We note that 74 of Ohio s 88 counties now have organized soil conservation districts

We note greatly increased attention given by public and private agencies to water conservation as it involves the retention of water where it is needed and also as it involves soil loss and floods

We note greatly increased attention given by public and private agencies to the problem of water pollution in all its aspects

We note increased attention to the matter of the conservation and restoration of our forests, to the development of ground cover for eroded lands, for the development of better land use programs in agriculture

We note the development of programs for the conservation and restoration of wild life and these programs also have engaged the attention of private as well as state agencies

We submit the thought that the research and the techniques resulting from such study which will result in an intelligent, comprehensive and correlated program of conservation lie entirely within the field of applied sciences and thus fall within the province of The Ohio Academy of Science

It has been the practice in the past for this committee to recommend that the members of the Academy as individuals, should not only make available to all agencies engaged in conservation their knowledge but to take an active part in conservation activities However, the conservation of the natural resources of our state has now become a problem of such outstanding importance to the economy of the commonwealth that there is a feeling in the minds of your committee that the time has arrived for the Ohio Academy of Science to take an active and well-planned part as an organization in Ohio's program of conservation

Therefore, your committee suggests and recommends that the President of the Academy shall create a Planning Board to formulate a suggested plan for the Academy's participation in the conservation program We suggest that this planning group should include, in addition to the members of the conservation committee, such members of the Academy as can be of service in formulating the plan, these to be chosen by the President of the Academy We suggest that the President set a date for the meeting or meetings of said Planning Board We also suggest that it would be desirable for the Planning Board to have at least a preliminary report to present to the winter meeting of the Council of the Academy

We suggest that the time and manner in which the final report of the Planning Board is to be presented to the Academy for discussion and approval shall be left to the discretion of the President

Respectfully submitted,

C E Taft,	E S Thomas,
R V Bangham,	Paul B Sears,
R W Franks	F J Wright,
C A Dambach,	A W Harper, *Chairman*

REPORT OF THE COMMITTEE ON NECROLOGY

The Committee on Necrology reports with deep regret the death of six members of the Academy since the last annual meeting The following memorial statements were written by colleagues of the deceased members as indicated by the name following each statement

Respectfully submitted,

H R Eggleston,
Karl Ver Steeg,
J Ernest Carman, *Chairman*

Rolland Craten Allen

The State of Ohio, the nation, the mining industry, and the scientific world lost an outstanding and distinguished citizen by the death of Rolland Craten Allen on July 18, 1949 Mr Allen was born at Richmond, Indiana, in 1881, spent most of his early manhood in Wisconsin, about ten years of his middle manhood in Michigan, and the rest of his life as a citizen of Ohio He received the Bachelor's degree from the University of Wisconsin in 1905, the Master's degree in 1908, and was awarded the honorary degree Doctor of Engineering by Rensalaer Polytechnic Institute in 1939

Dr Allen's service was both varied and important After receiving the Bachelor's degree he taught high school at Plymouth, Wisconsin, and conducted geological exploration in Ontario, Canada After receiving the Master's degree he was instructor in geology at the University of Michigan for one year (1908–1909) and then became State Geologist of Michigan, where he served for about ten years From 1919 to 1947 he was connected with the Lake Superior Iron Ore Association, Cleveland, Ohio, first as vice-president and then as president In 1921 he became executive in charge of mining operations for Oglebay, Norton and Co, Cleveland, and in 1924 executive vice-president While serving with that company (1930–31) he went to Russia as an adviser on developing iron ores for the Russian government He served the United States government during the first world war as a member of the Federal Excess Profits Tax Board, in charge of matters relating to natural resource industries, and again during the second world war with the Advisory Committee for National Defense, handling procurement of strategic minerals for iron and steel production, and with the War Production Board as vice-chairman of minerals and metals

He was a member of the American Institute of Mining and Metallurgical Engineers (director, vice-president, president), the Society of Economic Geologists (director, vice-president), a fellow of the Geological Society of America, a member of the Mining and Metallurgical Society of America, the American Iron and Steel Institute, the American Academy of Political Science, the Cleveland Engineering Society, the American Association for the Advancement of Science, and the Society of the Sigma Xi He was trustee of Western Reserve Academy, Hudson, Ohio (his home town), and trustee and president (at the time of his death) of Battelle Memorial Institute, Columbus, Ohio

Mr Allen's clear thinking, breadth of vision, good judgment, and understanding of people made him an outstanding personality Of him it has been said by a close associate that he "rendered unique service to his profession, to the mining industry and to his country, and created for himself a place in the hearts of all who knew him that remains an inspiration to them and a tribute to him as a splendid citizen."—*Carl A. Lamey.*

ARTHUR RIGGS ALTICK

Arthur Riggs Altick was born in Dayton, Ohio, June 22, 1891, and died July 21, 1947, from injuries received in an automobile accident. He graduated from the Springfield High School, Class of 1912, and later attended Wittenburg College. Early in his career he served as Secretary of the Springfield Chamber of Commerce, during which time he was active in Boy Scout affairs.

In 1933 Mr. Altick was elected Secretary of the Clark County Historical Society and Curator of its museum, which positions he held until his death. In this capacity he explored prehistoric mounds and village-sites in Clark and adjacent counties. He was an able artist, and his numerous reports of explorations, published in newspapers and magazines, were illustrated by his personal drawings. At the time of his passing he had in preparation a book length manuscript recording his explorations and illustrating artifacts in the Clark County Museum and elsewhere.

Mr. Altick held memberships in the Ohio Academy of Science and the Society for American Archaeology. He is survived by his widow, Ethel, and two sons, Richard and Arthur.

—*H. C. Shetrone.*

FLOYD C. DOCKERAY

Floyd C. Dockeray, Professor in the Department of Psychology at The Ohio State University, died January 15, at the age of 68. His academic training was received at the University of Michigan with a Bachelor's degree in 1907, a Master's degree in 1909, and a Doctor's degree in 1915. He taught at the University of Kansas from 1910 to 1915 and 1917 to 1920, and then went to Ohio Wesleyan where he was chairman of the Psychology Department until he came to Ohio State in 1929. One of his major contributions at Ohio State was the supervision of the introductory courses in the department. He also contributed to the advanced teaching program and supervised the research work of many graduate students.

His research interests have been primarily in general and comparative psychology but also to some extent in aviation psychology. During the first war he contributed some pioneer work on the selection of airplane pilots and also learned to fly in that connection. For a time he supervised the infant behavior laboratory operated by the Psychology Department and the Medical School. During and subsequent to the last war he was active in aviation psychology problems and directed a number of projects sponsored by the National Research Council. His writings involve numerous research articles and a widely used textbook in beginning psychology. Doctor Dockeray belonged to Phi Beta Kappa, Sigma Xi, American Psychological Association, American Association for the Advancement of Science, Southern Society of Philosophy and Psychology as well as our own Ohio Academy of Science. In the long perspective he will be remembered best by some of his research contributions to theoretical psychology and by the careers of advanced students to whom he gave generously of his time in helping plan their graduate programs.—*Harold E. Burtt.*

WILLIAM CLARENCE EBAUGH

William Clarence Ebaugh, Professor of Chemistry at Denison University, 1917–1944, died December 28, 1948, a few days prior to his seventy second birthday.

He was born and educated in Philadelphia and received from the University of Pennsylvania the degrees of B. S. (1898) and Ph. D. (1901). During his earlier years he served as a chemist in an iron and steel laboratory near Reading, Pennsylvania and with the American Smelting and Refining Company, Salt Lake City, Utah. He taught physics and chemistry at Kenyon College, Ohio (1901–1902) and from 1903 to 1915 was Professor and Director of the Department of Chemistry at the University of Utah.

From 1917 until the time of his serious illness in October, 1944, he was Professor of Chemistry and Department Head at Denison University, excepting the academic year 1930–31, when he taught as an exchange professor in Robert College, Istanbul, Turkey. After his illness in 1944 he lived in retirement, as Professor Emeritus in Granville.

In addition to his teaching and administrative duties he was active throughout his professional career as an industrial research worker, and as editor of scientific journals. His industrial research dealt primarily with steel analysis, smelter smoke, pollution of the atmosphere by smelter fumes, and gas producers. In Utah he served as associate editor of the *Journal of Industrial and Engineering Chemistry* and at Denison he was for over twenty years the Secretary of the Denison Scientific Association and Editor of the *Journal of the Scientific Laboratories.*

Dr. Ebaugh was a member of many learned and professional societies, including the Ohio Academy of Science, the American Chemical Society, the American Association for the Advancement of Science, and the American Society for Engineering Education. He was a member of Sigma Xi, and of Beta Theta Pi, social fraternity. He served long and faithfully in the Baptist Church. His avocation was music and he was an excellent organist.

Dr. Ebaugh will be long remembered by his many students, associates and friends as a vigorous man staunch and energetic, kindly, sympathetic, generous and reliable as a friend and counsellor His was a full life, filled with willing services—to family, students, and friends —*W A Everhart*

EDWIN LINCOLN MOSELEY

On June 6 1948 Bowling Green State University lost one of her pioneer professors, and the Ohio Academy of Science one of its founders and charter members by the death of Dr Edwin Lincoln Moseley Of frail physique throughout life he was nevertheless active almost to the time of his death having shortly before made a second trip to Mexico

Born in Union City Michigan, in March, 1865, Edwin Moseley entered the University of Michigan at the age of sixteen and received the A B and M A degrees in 1885 After teaching for two years in the Grand Rapids High School he joined the Beal Steere Zoological Expedition to the Philippines and returned with the nucleus of what grew to be a very good collection of bird and mammal skins By nature a prodigious collector of all kinds of scientific and historical materials, he developed a museum in the Sandusky High School where he subsequently taught science for twenty five years In 1914 he was appointed a member of the original faculty of Bowling Green State University which position he held until his retirement in 1935 Ultimately the Sandusky Museum was merged with the collections at Bowling Green State University In 1943, he was awarded the degree of Doctor of Humane Letters and was given the title of Curator of the University Museum

The versatility of Professor Moseley is shown by the fact that during the early years at Bowling Green he taught geology, chemistry and physics as well as biology and by his authorship of books of such diverse character as ' Trees, Stars and Birds "Our Wild Animals and 'Other Worlds ' His journal papers were numerous and included such titles as "Milk Sickness Caused by White Snakeroot "Sandusky Flora and "Flora of the Oak Openings West of Toledo ' In his latter years he devoted much study to tree rings, on the thesis that they might reveal evidence that could be used to predict cycles of rainfall This work stimulated much interest both locally and across the continent

Living almost the life of a recluse, and abstemious to an extreme in matters pertaining to the comforts of life, Professor Moseley was quietly and unostentatiously philanthropic in numerous ways, taking much interest in, and often helping financially, students who showed promise of development but who were handicapped by lack of financial support It was in accord with this spirit that he willed his entire estate to aid worthy students at the institution in which he served so long

Affiliated with a number of organizations and societies, Professor Moseley was a lifelong member of the American Society of Mammalogists, the Wilson Ornithological Club, the Michigan Academy of Science and the Ohio Academy of Science (Secretary 1895–1903, President, 1904) —*Charles H Otis*

GUY F VANSICKLE

The Department of Chemistry of the University of Toledo sustained a sad and severe loss, on December 12 1948, in the sudden death of Professor Guy E VanSickle His contribution to higher education in his field at the university over a period of thirty years has been of inestimable value as has been his enrichment of the cultural and social life of the university faculty

Professor VanSickle received his undergraduate training at the Ohio State University Class of 1909 and continued in graduate study there to the Master s degree in 1911 He then taught chemistry in the Toledo high schools until 1918 when he was appointed Professor of Chemistry at the University of Toledo He was a member of the American Association of University Professors the Ohio Academy of Science and the American Chemical Society He was one of the founders in 1917 of the Toledo Section of the American Chemical Society and had been, at various times, secretary chairman and councillor For many years he gave freely of his time and counsel as adviser to Chi Rho Nu fraternity

Through his genial and friendly nature his effective teaching techniques and his willing counsel Professor VanSickle made a host of friends among his students his associates and his wide circle of acquaintances in Toledo He is survived by Mrs VanSickle and three sons, Homer, Carl and James —*Harold G Oddy*

REPORT OF COMMITTEE ON RESOLUTIONS

Be it Resolved, that the Ohio Academy of Science express to President Kenneth I Brown of Denison University and to the local committee under the able leadership of Dr A W Lindsey its appreciation of the hospitality so freely extended and the excellent facilities furnished in this most inviting collegiate environment which have made this our fifty-eighth annual meeting, so pleasant and successful

Be it further Resolved that the Ohio Academy of Science express to Dr Wilbur M Tidd its thanks for his efficient services as Treasurer of the Academy, from which position he has recently resigned

Respectfully submitted

P B SEARS,
W C BEAVER,
W C KRAATZ, *Chairman*

THE OHIO JOURNAL OF SCIENCE

VOL XLIX SEPTEMBER, 1949 No 5

NUMERICAL ABUNDANCE AS THE CRITERION FOR SUCCESSFUL SPECIES

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In introducing his discussion of this subject, Professor A Franklin Shull says, "Even as late as the early years of the present century a work canvassing the status of Darwinism at that time, referred to natural selection, on page after page as involving life-and-death distinctions Conn, some years earlier had pointed out the needlessness of this assumption, and occasionally others shared his view But for a long time the prevailing assumption was that a character must save a life that would otherwise be destroyed, or destroy an individual which without that character could survive, if natural selection were to work" (1936 p 152)

It must be noted, nevertheless, that if the Darwinism theory is being adhered to, the view cited must be retained Darwin says that 'any variation in the least degree injurious would be rigidly destroyed' (?1912, p 70), and that 'A grain in the balance may determine which individuals shall live, and which shall die—which variety or species shall increase in number, and which shall decrease, or finally become extinct" (ibid, pp 454-5)

Shull goes on to inquire, "What should supplant this view? To answer this question it need only be recalled that success or failure depends on numbers" (1936, p 152) "Numbers in whatever manner attained constitute the best assurance of permanence" (ibid, p 153) "Even a very slight percentage increase, not necessarily occuring every generation but perhaps only occasionally, should suffice eventually to enable the favored type to supplant those less favored It is clear, therefore, that natural selection need not render life-and-death decisions in order to work Mere differential numbers suffice Recognition of this fact alters somewhat the criticisms that may be leveled against it, and conclusions regarding what it can accomplish" (ibid p 154)

It is difficult to see why any effort should be made to retain the term "natural selection" since it is probably the most unfortunate that ever afflicted biological science At any rate the thing that Shull is talking about is not Darwinian natural selection but numerical dominance Darwin insisted upon numbers as the criterion of success in evolution but it was always numbers attained by mitigation of destruction (?1912, p 59), by protection from predation or from other environmental checks (ibid, p 94) The theory should not be warped away from its original form and still be represented as the same This gives Darwin undue credit and proponents of the new view unjust advantage from his prestige

The present criticism is not directed particularly against Shull—he merely furnishes quotable extracts good for a take-off "The leaving of many descendants is recognized as the criterion of success" (1936, p 212), he continues and repeats "success in evolution depends on numbers" (ibid, p 217)

The objections that can be urged against this point of view are numerous and weighty In the first place it must not be forgotten that "natural control is necessary and inevitable No species can go on increasing in numbers indefinitely" (Moss, 1933, p 220) In fact, self-limitation of populations is a widespread, perhaps a universal, phenomenon (McAtee 1936) That would not be the case if numbers alone were necessary for "success"

Again, whether as a function of natural control, or not, the carrying capacity of the environment for any organism has an upper limit that apparently cannot be transgressed more than temporarily There is in effect, therefore, regardless of its mechanism, what amounts to a direct limitation of numbers by environmental influences Carrying capacity thus rather rigidly regulates populations and is far from leaving attainment of abundance as something to be achieved through merit of the intrinsic qualifications of an organism

It is certainly worthy of note also that the "leaving of many descendants" is characteristic chiefly of species that manifest excessive reproductive effort a process that is almost invariably accompanied by a high percentage of failure Call such species "successes" if you will, but face the question, Are species successful from an evolutionary or any other point of view when they must produce a thousand or more eggs, a million or more sperms for every individual brought to maturity? Under the selection principle of adaptation they must be regarded as very crudely adapted, and it is difficult to see how they can be esteemed as successful under any phase of natural selection doctrine with its fetish of "survival of the fittest"

As a theoretical consideration it may be pointed out that it is just those species with a low birth rate that would seem most likely to be moulded by the alleged perfecting influence of natural selection, for the reason that there would be less scope in their case for indiscriminate elimination of progeny On these grounds, under the theory, the species most affected by natural selection, namely, the rare ones, would be the most successful Attainment of large numbers would hardly seem a "natural selection" phenomenon, anyway, as "natural selection" is exclusively a destructive or checking influence

One of Darwin's remarks upon the subject of numerous progeny is, "the real importance of a large number of eggs or seed is to make up for much destruction at some period of life" (?1912, p 59) Like many another statement, this gives natural selection on anticipatory effect which, of course, it could not have Destruction, moreover, is not a fixed toll but is more or less in proportion to production If this were not the case, species would never recover from descending oscillations in numbers, although they regularly do

If "success in evolution depends on numbers," how has it happened that organic populations have evolved, almost everyone of which undergoes profound fluctuations in numbers? One enthusiastic selectionist has asserted that "for an animal species in a state of nature, a declining population involves grave hazards" (Williams, 1932, p 306) If this be so, why has natural selection permitted fluctuation to be a characteristic of apparently all organic populations? Why does it allow all more or less regularly to decline in numbers?

In various well-known instances, fluctuations occur regularly at intervals of a decade or less According to the numerical criterion of success, these species are successful at the crest of the population wave, unsuccessful at the trough That the same species can be both successful and unsuccessful, evolutionarily speaking, and that too within ten or fewer years is another of the paradoxes to which selectionists are so hospitable

As to fluctuations, if numbers were a guarantee of "success," populous species would not lose their abundance, and if numbers were necessary to "success," species could not regain them after a "low" The fact that both phenomena are of regular occurrence is another of the many evidences that "natural selection" is not in control

One of the Darwinian tributes to numerical abundance is "a large stock of individuals of the same species, relatively to the numbers of its enemies, is absolutely necessary for its preservation" (?1912, p 62) If numbers are so vitally important, it certainly is pertinent to inquire why the strictly utilitarian principle of "natural selection" has permitted establishment of an almost universal feature of the cutting down of the numbers of all organic populations by an enormous percentage (90–99 or more) in every generation.

A fact overlooked in connection with the Darwinian edict quoted is that predation tends to be proportional to population (McAtee, 1932, 1934, 1935) Rarity, in itself, protects both by evading notice and by forcing enemies to turn their attention to more abundant sources of subsistence The prey-predator, is just as important as the predator-prey, relationship The enemies of cyclic species have a low immediately following that of their prey but in the transition period with prey scarce, predators not yet scarce, there is no indication of extermination, the last few of anything are hard to find

When as in the predator-prey or parasite-host relationship, numbers of a species depend on those of one or more food or host organisms, they may fluctuate without regard to survival value of their own characteristics More hosts, more prey, bring an increase in no way due to excellences of the dependent species Such attainment of numerical abundance is not a result of survival of the fittest for "natural selection" of species (the dependents) cannot be based on the qualifications of other species (the supporters)

The very term numerical dominance implies the contemporaneous existence of less numerous, along with the more numerous, species This is not only a fact of every-day observation but the fundamental phenomena of food-chains and other inter-organismal dependencies clearly demonstrate that it has always prevailed The success of parasites and predators cannot be measured by numbers because the more numerous they are, the more they prejudice their own interests Consumers must be fewer in numbers (or less in bulk) than producers This is a truism, an inexorable law, that has prevailed throughout the whole course of evolutionary history

This fact alone proves that less numerous species have been just as successful as the more numerous They have maintained existence in numbers appropriate to their ecological status and as permitted by the dominating principle of fluctuation There have been rare, there have been common, there have been abundant, species in all states of evolution The less common, so far as we can judge from paleontological evidence, have been no more prone to extinction that the more common Among the latter, some Brachiopods, for instance, were so abundant that the shells of the dying formed thick beds of limestone The same is true of certain Crinoids, while some Foraminifera have a similar relation to chalk Some of the plants that were the basis of coal deposits must have been very abundant All of these organisms and many more, that could be named, once were very numerous but now are totally extinct Their history amply refutes the dictum that "success in evolution depends on numbers"

Taxonomic investigations of large groups characteristically show that the wide-ranging and common, that is dominant, species are relatively few, while those of more restricted range and populations are relatively numerous Ecological study generally confirms the principle stated by Raunkiaer that "the least frequent species are much the more numerous" (1934, p 397) An evolutionary theory based on dominants, therefore, ignores a large numerical preponderance of species As all are the product of evolution and as all are concerned in whatever evolution is now occurring, the theory cited can hardly be regarded as satisfactory

In logic, and in fact, a species, whether common or rare, is "successful" so long as it has a place in the sun Since none forever maintains place, none is permanently successful Evolution is not a record exclusively of "successes," it is a story of the origin and rise, decline and extinction of all organisms, and withal is one so consistent that we can hardly suppose that there ever have been or ever will be any exceptions If we read evolutionary history aright, there are, in the last analysis, no "successful" species, for all eventually disappear

Darwinism is a theory of the transformation of organic forms by mass variation and "natural selection " The importance of numerical advantage is emphasized by iteration and reiteration but what has the theory to say of the less numerous and of the rare, that have undoubtedly been present at all stages of evolution? That they kept evolutionary pace with the more numerous species is demonstrated by their presence in every phylum today

Despite the Darwinian "view of the necessity of a large stock of the same species for its preservation" (?1912, p 62), all species could not have developed by transformation of existing abundant species, for in that case the total number of species evolved would have been relatively small instead of extremely high as is actually the case It is not only natural to believe, but under the circumstances, it is a logical necessity to conclude, that many, probably most, species originate in small numbers Darwin seemed to view rarity as "the precursor to extinction" (ibid., p 94), but it would seem equally well regarded as the normal state of a new form Willis defends this view in "Age and Area" and a distinguished geologist (R H Rastall) says "It may safely be assumed that any given species arises at a point, or within a very small area, and spreads outward by migration " (1929, p 170) On this eminently reasonable view, it must be concluded that, as a rule, species in their origin (and this is what Darwin was writing about) lacked the very thing, numbers, upon which success in evolution is said to depend

De Vries, concurring with Willis, notes that, "all over the earth and in every systematical group of plants the rule prevails that the most wide-spread species are the oldest " (1918, p 630) This principle of course applies to organisms only in the assurgent phases of their history but it makes numbers (before senescence) a function of the ages of organisms—quite a different thing from being the result of the ' survival of the fittest "

This essay presents evidence along about a dozen different lines, all to the effect that success in evolution does not depend on numbers Possession of great numbers is no guarantee of success, and lack of them no threat of failure Whatever their relative average abundance, all organisms fluctuate in numbers On the numerical criterion, all must, therefore, be classed as both successful and unsuccessful The latter label fits all in the end, for whatever their quondam prosperity, all at length becomes senescent and finally extinct

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A REVIEW OF THE NORTH AMERICAN SPECIES OF TEXANANUS (HOMOPTERA—CICADELLIDAE) NORTH OF MEXICO

DWIGHT M DeLONG AND RUTH V HERSHBERGER
Ohio State University

The genus *Texananus* was established by Ball in 1918 and *Phlepsius* (*Texananus*) *mexicanus* was designated as the genotype In characterizing this group Ball stated, " with head narrower than pronotum, front rather broad, convex, widening above the antennae and approaching the eyes Vertex bluntly conical, the margin to the front rounding Pronotum large, broadly and evenly rounding in front, the lateral margin long, oblique and definitely carinate "

The species occurring in the United States have been described in various journals (partly as *Phlepsius*) An attempt has been made here to bring together all this material from various sources, illustrate the diagnostic characters of both sexes in so far as these are known, establish further synonomy and present a key for their separation *T* *areolatus* with its sharp margined vertex and genitalic structures seems to be distinct from the other species A new subgenus *Aridanus* is suggested for it

Certain groups of closely related species are found in this genus The short robust species of the *ovatus* group are represented by *ovatus*, var *distinctus*, *denticulus*, *bialtus*, *gladius*, *latipex*, *lathropi*, *delicatus*, *pergradus*—probably the same as *delicatus*—*sonorus* and *deversus*, a new species described below Four species, *superbus*, *angus*, *vermiculatus* and *oregonus*, represent another small group *T* *excultus*, *dorothyae*, *incurvatus* and *neomexicanus* comprise another group of closely related species A fourth group is composed of *graphicus*, *marmor*, *monticolus* and *cumulatus*, which are quite similar in form *T* *decorus* and *dolus* are similar and are closest in form to the *ovatus* group *T* *rufusculus* is rather distinct in type of genitalia It is probably most closely related to *decorus*

KEY TO SUBGENERA

1 Vertex convex above, sloping to margin which is thick although angled with the front Subgenus *Texananus*

1' Vertex depressed on disc behind margin, definitely excavated the margin sharp, foliaceous The face is more flattened Subgenus *Aridanus*

Subgenus Aridanus nov

This group is characterized by a vertex narrower than the pronotum and which is definitely depressed or excavated on the disc, margin of vertex sharply angled with front, thin and foliaceous The aedeagus of the male is composed of a single process with a broad erect basal portion

Genotype *Texananus areolatus* (Baker)

Texananus areolatus (Baker)

Phlepsius areolatus Baker Can Ent 30 30, 1898.

A broad, robust species, ivory white, tessellate with brown fuscous and black Length 6 mm

Vertex broad, about one-third longer on middle than next the eyes. Color—entire insect mottled or tessellate, anterior margin of vertex alternating with ivory and black spots Irrorations of elytra often forming definite areolar spots.

Female seventh sternite with posterior margin broadly shallowly emarginate, a short V-shaped notch at apex, a brown spot on either side. Male plates short broad, rounded, almost semicircular Aedeagus composed of a basal portion which is enlarged dorsally and produced, bearing a narrowed, anteriorly curved, dorsal process. A long ventral process is narrow and produced caudally Pygofer short, broadly truncate posteriorly

This species was originally described from specimens collected in Kansas. It is a typical prairie species and has been found only in areas of prairie in the central states, particularly those in the Mississippi and Missouri valleys.

Subgenus Texananus Ball

The vertex margin is angled with the front but thickened Vertex convex above, sloping to the margin

KEY TO SPECIES OF SUBGENUS TEXANANUS

1 Ninth segment with a tubular ovipositor (female) 2
1' Ninth segment without a tubular ovipositor but with two triangular or rounded plates (male) 14
2 Median portion of seventh sternite produced beyond the posterior margin of the lateral angles 3
2' Median portion of seventh sternite either excavated or notched not as long as lateral margins 4
3 Posterior margin of seventh sternite roundedly produced from base to form a pair of median approximate rounded teeth *rufusculus*
3' Posterior margin of seventh sternite with four distinct teeth on median half The outer tooth on each side separated from the inner pair by a rounded notch *denticulus*
4. Seventh sternite short, posterior margin concavely rounded notch at middle appearing square with lateral margins parallel *lathropi*
4' Seventh sternite without parallel margined notch or, if U shaped, without concave posterior margin 5
5 Posterior margin of seventh sternite broadly excavated without a median notch 6
5' Posterior margin of seventh sternite either not broadly excavated or, if so excavated, with a median notch 10
6 Lateral portions of preceding sternite conspicuous at lateral margins or along posterior lateral margin of excavation of seventh sternite 7
6' Without visible lateral portions of preceding sternite in excavated portion of seventh sternite 9
7 Lateral portions of sixth sternite decidedly produced on posterior lateral margin of seventh sternite *dorothyae*
7' Visible lateral portions of sixth sternite smaller, less conspicuous, usually not produced posteriorly 8
8 Seventh sternite long with a rather deep and more narrowed excavation *neomexicanus*
8' Seventh sternite shorter more broadly excavated *incurvatus exculius*
9 Seventh sternite broadly roundedly notched almost to base *vermiculatus*
9' Seventh sternite with shallow excavation reaching not more than half way to base, *superbus, angus, oregonus*
10 Posterior margin of seventh sternite with a deep, rather broad, V shaped notch at the base of which on either side is a distinct rounded notch The V-shaped median notch separated from the lateral rounded notches by a distinct tooth 11
10' Median notch broad and shallow or with rounded apex 12
11 Posterior margin of seventh sternite rounding from base without distinct lateral angles *cumulatus graphicus*
11' Posterior margin of seventh sternite with more distinct lateral angles *monticolus, marmor*
12 Seventh sternite with definite produced lateral angles 13
12' Lateral margins of seventh sternite rounded from base to produced posterior margin—without lateral angles *decorus, dolus*
13. Seventh sternite short, median notch shallow, very narrow at apex, *ovatus, pergradus, latipex, distinctus*
13' Seventh sternite rather long, lateral angles strongly produced, broadly rounded Median notch extending more than half way to base, notch U-shaped broad at apex *sonorus*
14. The aedeagus with a basal portion, dorsally produced and connected to ventral portion by a narrow, usually elongated process 18

14' The aedeagus consisting of one process or with the basal portion broadly attached to body of aedeagus 15

15 Pygofer almost twice as long as plates *neomexicanus*

15' Pygofer shorter than or not more than one-half longer than plates 16

16 Pygofer shorter than plates *dorothyae*

16' Pygofer longer than plates 17

17 Aedeagus conspicuously thicker on base and at middle than apical portion pygofer slightly exceeding plates *excultus*

17' Aedeagus tapered at base and at apex, slightly broadened at point of attachment to connective pygofer exceeding plates by about one-half their length *incurvatus*

18 The ventral portion of the aedeagus composed of a pair of divergent processes the dorsal portion single 19

18' The ventral and dorsal portions of the aedeagus each composed of a single process 22

19 Ventral aedeagus processes blunt at apex, enlarged by dorsal and ventral finger like processes *oregonus*

19' Ventral aedeagus processes elongate slender at apex 21

20 Ventral processes long, curved with a branched portion arising at about half their length *vermiculatus*

20' Ventral processes shorter straight or slightly curved at apex 21

21 Male plates short and broadly rounded greatly exceeded in length by pygofers *superbus*

21' Male plates triangular, bluntly pointed at apices almost as long as pygofers *rufusculus*

22 Ventral portion of aedeagus straight pointed on ventral margin at apex with a pair of pointed teeth on dorsal margin just before apex *ovatus* & var *distinctus*

22' Ventral portion of aedeagus bent or, if straight, without teeth or other projections 23

23 Ventral portion of aedeagus bent abruptly ventrally then narrowed and pointed at apex *deversus*

23' Ventral portion of aedeagus not bent abruptly near apex 24

24 Dorsal aedeagus with the apex bifid *latipex*

24' Dorsal aedeagus curved to form a pointed apex 25

25 Ventral portion of aedeagus slender from base to apex not exceeding dorsal portion in length *pergrada*

25' Ventral portion of aedeagus broader or, if slender, longer than dorsal portion or both 26

26 Styles notched at apex the outer margins produced and pointed *lathropi*

26' Styles not notched at apex 27

27 Ventral portion of aedeagus broad at base tapered narrowed to pointed apex 28

27' Ventral portion of aedeagus not tapered from base to apex 30

28. Base of dorsal aedeagus portion broadened and thickened 29

28' Base of dorsal aedeagus portion more narrowed *denticulus*

29 Thickened basal portion of dorsal aedeagus produced so as to leave only a small opening between projected portion and apex *bialtus*

29' Thickened portion of dorsal aedeagus not strongly produced opening between projection and apex broad *sonorus*

30 Ventral aedeagus broadened and blade-like either throughout or near middle 31

30' Ventral aedeagus about the same width throughout, not blade-like 35

31 Ventral aedeagus blade-like or broadened to near apex 32

31' Ventral aedeagus broadened near middle or on apical half 33

32 Ventral aedeagus distinctly longer than pygofer curved upward toward apex plates short, blunt, rounded *gladius*

32' Ventral aedeagus scarcely exceeding pygofer, slightly curved downward toward apex, plates longer, more produced, blunt at apex *dolus*

33 Ventral aedeagus enlarged at about middle, dorsal aedeagus scarcely enlarged at base *decorus*

33' Ventral aedeagus enlarged on apical portion just before apex, dorsal aedeagus decidedly thickened on basal half 34

34 Styles short, blunt apical portion broad, slightly produced on outer margin *marmor*

34' Styles elongate, apical half narrowed and produced, apices narrow, blunt *graphicus*
35 Ventral aedeagus curved upward at apex, dorsal aedeagus elongated, plates short, rounded, greatly exceeded by pygofers *monticolus*
35' Ventral aedeagus more slender, straight, dorsal aedeagus shorter, thicker at base, plates more elongate, blunt at apex, exceeded less by pygofers *cumulatus*

Texananus rufusculus (Osborn & Lathrop)

Phlepsius rufusculus Osb & Lath Anns Ent Soc Amer 16 340, 1923

A rather large robust reddish brown species resembling *superbus* in general form Length 7–7.25 mm

Vertex one-fourth longer on middle than next the eyes. Color yellowish with reddish brown irrorations, anterior border of vertex ivory yellow

Female seventh sternite broadly, roundedly produced from base to a pair of short, broadly rounded teeth separated by a narrow notch Male plates rather long, triangular, with bluntly pointed apices. Aedeagus with a pair of ventral lateral processes which are divergent, and a median process which is enlarged at the base, abruptly tapered to a long, slender, tapering process

Originally described from Ohio and Missouri, it has since been collected in southern Illinois. It has been collected only in moist woodland or wooded floodplain areas on rank growing herbaceous vegetation

Texananus neomexicanus (Baker)

Phlepsius neomexicanus Baker Psyche 7 18, 1895

Related to *excultus* and *incurvatus* but with a much longer pygofer Length 7–8 mm

Vertex produced and bluntly angled almost two-thirds as long at middle as basal width between the eyes

Color Pale with few dark markings on vertex pronotum and scutellum Elytra with brown veins and rather heavily marked with brown pigment lines.

Genitalia Female seventh sternite with broad, prominently produced lateral angles between which the posterior margin is broadly deeply, concavely excavated almost to base Portions of the preceding segment are visible at either side. Male plates rather long, apical half tapered to pointed apices. Style rather broad, the apex with a curved finger like process arising on inner margin curved outwardly Aedeagus attached to connective at about its middle. The median portion broadened The basal portion narrowed and extending dorsally, the apical third narrowed, recurved on basal portion and tapered to a slender apex The pygofer is extremely long, almost twice as long as plates.

This was described from New Mexico and is found only in the southwestern states

Texananus excultus (Uhler)

Jassus excultus Uhler Bull U S Geol & Geog Surv 3, 467, 1877

Related to and resembling *superbus* in general form and size. Length 6–6 5 mm

Vertex about one-fourth longer on middle than next the eyes. In color the vertex, pronotum and scutellum are tawny yellow, the elytra are darker brownish

Female seventh sternite broadly excavated two-thirds the distance to base Not far from the lateral margins on each side, the sides of the sloping lateral margin are slightly produced and rounded Portions of the underlying segment are exposed at the sides of the excavation Male plates broad triangular, apices bluntly pointed Aedeagus with a basal, dorsally produced process which is tapered and bluntly pointed dorsally Apical portion narrowed, tapered to a slender pointed apex which is curved dorsally and anteriorly, almost touching the basal portion. Pygofers short and pointed, not exceeding plates

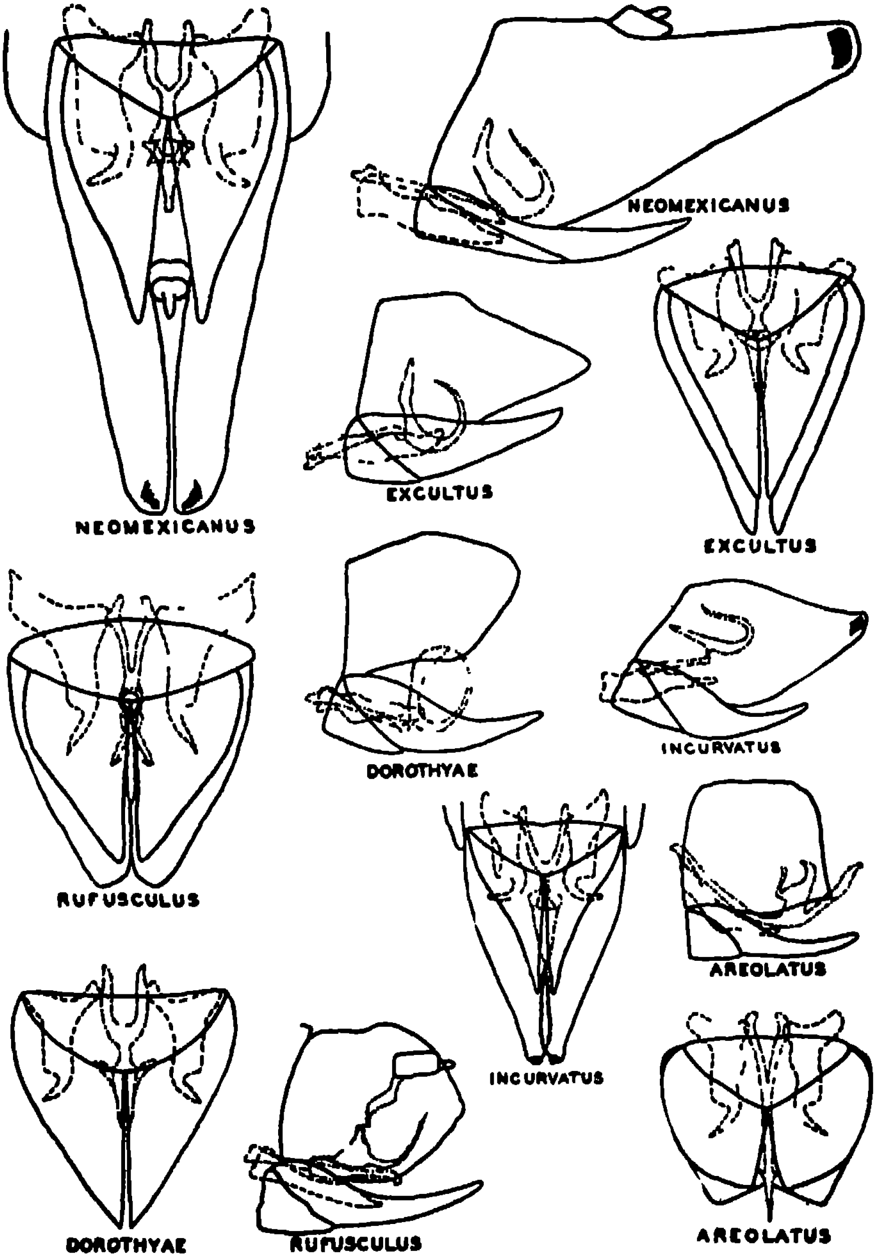
Originally described from the southern states, it occurs throughout the eastern and central states

Texananus dorothyae DeLong

Texananus dorothyae DeLong Anal Esc Nac de Cien Biol 1 387, 1939

Related to *excultus* and *incurvatus* Length 6.5 mm

Vertex bluntly angled almost one-half longer at middle than next the eyes, less than twice as wide between eyes as median length Color yellowish with pale brownish markings.



Lateral and ventral views of male genitalia of species of *Texananus* as named

Female seventh sternite short, broadly concavely excavated almost to base, the lateral portions of the underlying segment conspicuous for their entire width beyond the seventh sternite Male plates rather broad, triangular, apices pointed Plates as long as or exceeding pygofers, which are bluntly produced and rounded at apex Aedeagus similar to *excultus*, U shaped with the dorsal ends curved inwardly sometimes proximal The basal, dorsal end is broadest gradually tapered to a slender pointed apex

It occurs in the southwestern states The types are from Texas, Arizona and Mexico

Texananus incurvatus (Osborn & Lathrop)

Phlepsius incurvatus Osb & Lath Anns Ent Soc Amer 16 346, 1923

A species with the head distinctly angulate related to *neomexicanus* Length 5 5–5 7 mm

Vertex a little wider than length at middle nearly twice as long at middle as next the eyes Color gray irrorate with fuscous

Female seventh sternite rather short broadly, deeply, roundedly excavated almost to the base The lateral portions of the preceding segment visible at either side of the excavation Male plates elongate triangular, with acutely pointed apices about two-thirds as long as the pygofer The style is rather short and broad with an outwardly curved finger like process at apex originating on the inner margin The aedeagus is U shaped As compared to *neomexicanus* the portion of the aedeagus is more narrowed at the point of contact with the connective than in *neomexicanus* In *incurvatus* the pygofer exceeds the plates by about one-half their length in *neomexicanus* the pygofer exceeds the plates by about their length

This species was originally described from Arizona specimens It occurs in the southwestern United States and Mexico

Texananus oregonus Ball

Texananus oregonus Ball Pan Pac Ent 8 85 1931

Related to *superbus* but with distinct male genital structures Length 6 5 mm

Vertex bluntly angled about two-thirds as long at middle as basal width between the eyes Color brown with black markings at ends of claval veins along posterior margins of elytra

Female seventh sternite with lateral margins sloping to posterior margin which is broadly rather shallowly excavated less than half the distance to the base Male plates short and broad together semicircular in shape, exceeded in length by the pygofers The dorsal median process of the aedeagus is broad at base narrowed and curved apically The two ventral, lateral processes are broadened dorsoventrally and in lateral view are broadened at the apex and notched producing fingerlike processes which extend dorsally ventrally and caudally

This species was originally described from Oregon Washington and California and has since been taken in Arizona

Texananus vermiculatus DeLong

Texananus vermiculatus DeL Ohio Jour Sci 38 42 1938

Related to *superbus* which it resembles in general appearance Length 6 mm

The vertex is blunt almost twice as wide between eyes as the median length Color yellowish with brownish and black markings

The female seventh sternite is deeply and rather sharply excavated almost to base, forming a broad V-shaped notch with the apex widened Male plates short and broad, broadly rounded, together appearing semicircular in shape The aedeagus with three processes The median portion is short enlarged at base and curved dorsally The two lateral processes are long, slender curved dorsally then ventrally at apex A short branched process arises at about one-third the distance to apex The pygofer is long and blunt at apex

This species was described from specimens collected in Arizona and Texas

Texananus superbus (Van Duzee)

Phlepsius superbus Van Duzee. Trans Amer Ent Soc 19 81, 1892

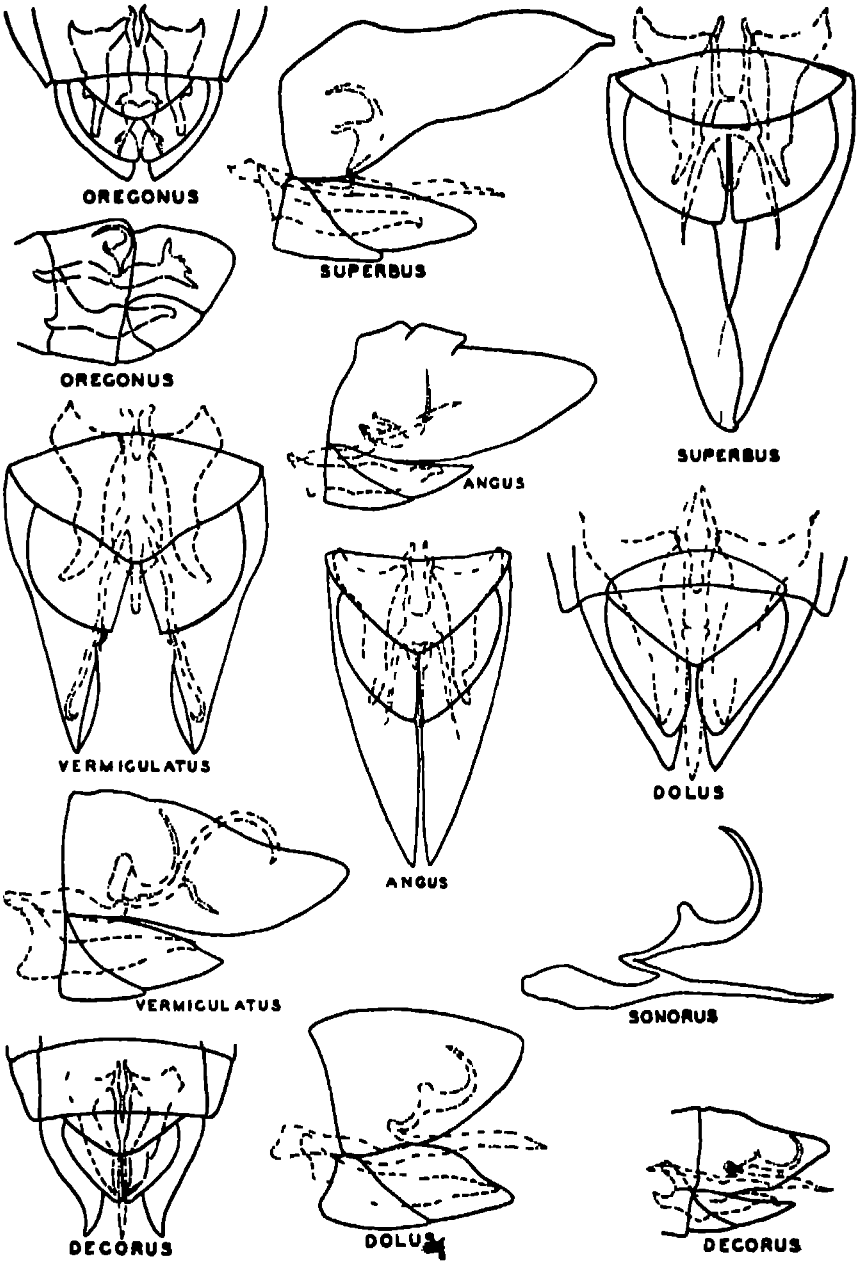
This species is broad narrow headed and robust Length 6 mm

Vertex roundedly angulate about two-thirds longer on middle than next the eyes Color pale brown irrorate with black and dark brown

The female seventh sternite is broadly excavated half way to the base The apex of emargi

North American Species of Texananus
Dwight M DeLong and Ruth V Hershberger

PLATE II



Lateral and ventral views of male genitalia of species of *Texananus* as named except *sonorus* which is lateral view of aedeagus only nation occupying about one-third of the entire width between the lateral angles is truncate. Male plates short, broad, together semicircular Aedeagus with a pair of long ventral processes which are abruptly narrowed on dorsal margin near apex and produced in narrow pointed apices. Dorsal process short, sickle-shaped, with the curved apex directed dorsally and anteriorly Pygofer long, tapered, concavely narrowed on ventral margin to a rather pointed apex.

Originally described from specimens from North Carolina and Arizona, it is a rather widely distributed species occurring throughout the southern United States and in several of the more northern states it occurs on grasses in meadows and pastures

Texananus angus DeLong

Texananus angus DeLong Ohio Jour Sci 38 42, 1938.

Related to *superbus* and the Mexican species *curtus* but with distinct male genital characters. Length 6–6 5 mm

Vertex bluntly angled, about one-third longer at middle than length next the eyes. Color brownish with darker brown markings.

Female seventh sternite broadly, angularly excavated more than half way to base, the apex of excavation rounded Male plates broad, rather short and bluntly pointed, almost rounded, at apex Aedeagus with three processes as in *superbus*, a pair of straight processes between which is a median portion with an enlarged base and an elongate slender apical two-thirds which is curved upward The pygofer is elongate and blunt at apex, about twice as long as plates, but shorter than *superbus*

Described from specimens collected in Texas, Oklahoma and Kansas

Texananus decorus (Osborn & Ball)

Phlepsius decorus Osb & Ball Proc. Ia. Acad Sci 4 230, 1897

A rather short, robust species with flaring elytra Length 6 mm

Vertex broadly, roundedly angulate, about one-third longer on middle than against the eyes. Color white marked with tawny, a transverse pale band on vertex Elytral commissural line on clavus with ivory white lobate spots

Female seventh sternite with lateral margins rounded to posterior margin which is almost truncate, median third broadly, deeply excavated, with a broad, but not rounded, apex at the middle extending two-thirds the distance to the base. Male plates short and narrow, triangular apices roundedly angled. Aedeagus with a long, slender, blade-like ventral process and a rather long, slender, dorsal process with apical third curved dorsally

Originally described from Nebraska and Iowa, it occurs commonly in grassy areas throughout the United States and the Mississippi and Missouri valleys

Texananus dolus DeLong

Texananus dolus DeLong Pan Pac Ent 14 186, 1938

Related to *decorus* but with longer male plates and a broader aedeagus. Length 6 5 mm

Vertex broadly rounded, about twice as broad between eyes as median length Color white marked with brown Elytra with a pale margin and spots along commissural line.

Female seventh sternite short, almost truncate, posterior margin with a V-shaped median notch about two-thirds the distance to base. A small notch on side walls of median notch either side is rounded to posterior margin Male plates triangular and slightly divergent, apices bluntly rounded Aedeagus in lateral view with a rather broad ventral portion which is pointed at apex on lower margin, the dorsal sloping to ventral margin, dorsal portion twice curved, the apical portion sickle-shaped, apical half tapered and pointed, curved dorsally and anteriorly

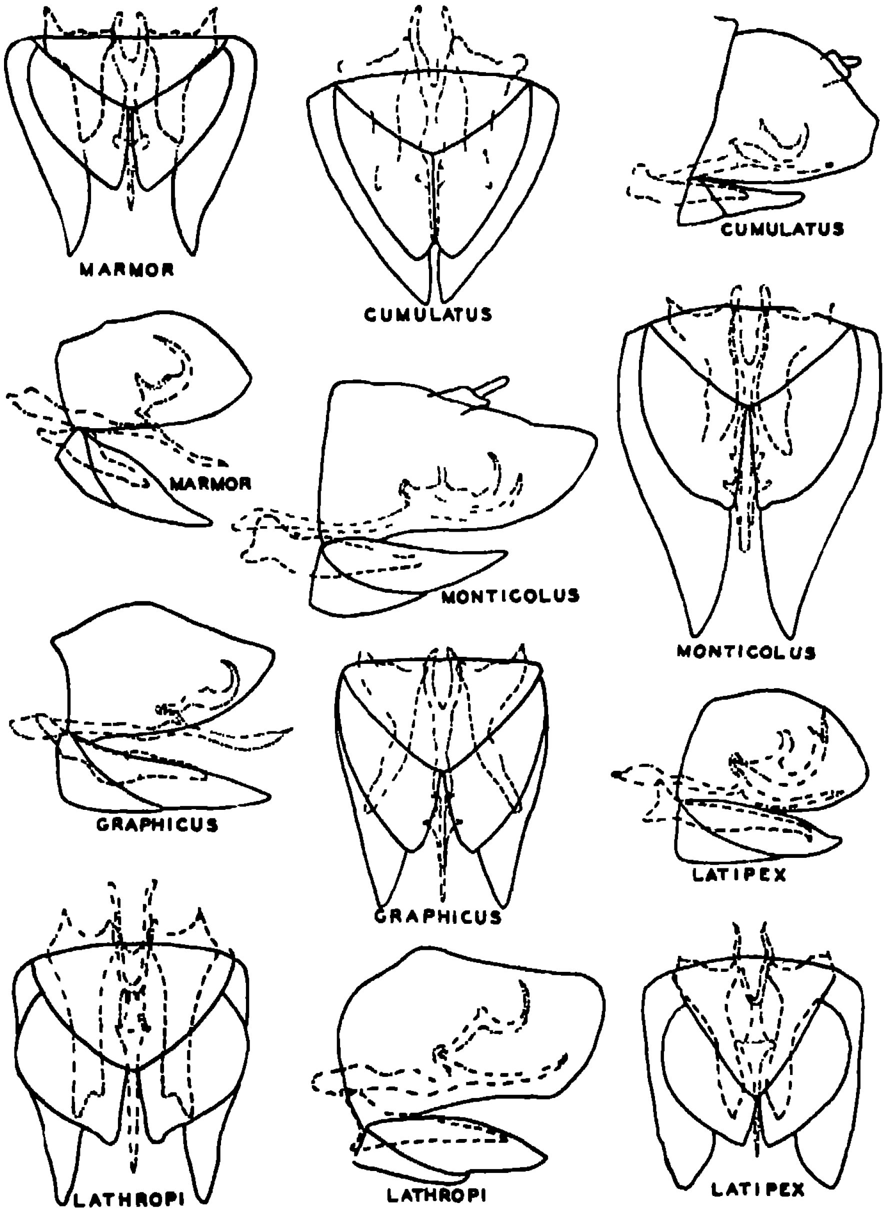
This species was originally described from Utah and has been taken only in the Rocky Mountain region

Texananus sonorus (Ball)

Texananus sonorus Ball Bull. Brook. Ent Soc 31 19, 1936

Related to *denticulus* which it closely resembles in type of male genitalia. Length, female, 6 mm

In coloration it is rather distinct with a pale, conspicuous commissure with the vermiculate lines fine and more numerous along the white commissure The female seventh sternite is rather



Lateral and ventral views of male genitalia of species of *Texananus* as named

long with a rather broad U shaped notch reaching more than half way to the base. The lateral angles are produced and rounded or bluntly angled The male plates are broad and short, together appearing semicircular The aedeagus is composed of two portions. The dorsal portion is sickle-shaped with a rather large base. The ventral portion is almost straight, tapered from base and narrowed to form a pointed apex.

The type specimens in the Ball Collection in the U S. National Museum have been examined and the accompanying illustrations made from the types.

Texananus ovatus (Van Duzee)

Phlepsius ovatus Van Duzee. Trans Amer Ent Soc 19 79, 1892

A small species, broad, short, ovate with a rather uniform brownish color Length 5 mm

Vertex bluntly angled, median length one-third to one-half greater than next the eyes Color dull yellowish with brownish irrorations

Female seventh sternite with lateral angles rather prominent between which the posterior margin is broadly, rather shallowly excavated. At the apex of the excavation is a small V-shaped notch Male plates quite short, broadly rounded, broader than long and decidedly exceeded by the pygofers The inner margins of the plates are divergent Styles long, the apical two-thirds is narrow and rather broadly, bluntly rounded at the apex The ventral portion of the aedeagus is straight, and rather heavy, sharply pointed on the ventral caudal margin and with a pair of pointed spines or teeth on the dorsal margin at the point where it begins to slope to the ventral apical pointed tip The dorsal portion is concavely rounded on the dorsal margin either side of a median, broad, slightly produced tooth The median portion just beyond tooth thickened, the apex is narrowed to a slender sharp pointed tip which is curved strongly dorsally and anteriorly

This species was described from specimens collected in Texas and is known to occur only in the southwestern states

Texananus ovatus var distinctus (Lathrop)

Phlepsius distinctus Lathrop Ohio Jour Sci. 17 129, 1916

The coloration is conspicuous, being ivory white marked with black or dark brown The elytra are ivory white with dark markings

Although slightly larger than *ovatus* and with a striking color pattern this form cannot be separated from *ovatus*, having identical male genitalia In view of the color pattern it has been placed as a varietal form under *ovatus*

All the specimens that have been observed have been collected in the southeastern portion of the United States

Texananus bialtus DeLong

Texananus bialtus DeLong Pan Pac Ent 14 185, 1938

Closely related to *latipex* and *pergrada* Length 6.5 mm.

The vertex is bluntly angled, about two-thirds as long at the middle as the basal width between the eyes The color is dull yellow with dark brown markings, the elytra are creamy white rather sparsely marked

The male plates are short, together almost semicircularly rounded. Styles broad at base, the apical two-thirds elongate and slender, blunt at apex, pointed on the inner margin The ventral portion of the aedeagus in lateral view is broadened at the base and tapers to a slender pointed apex. The dorsal portion is sickle-shaped with the base thickened and broadened The apical half is slender and tapers to a sharp pointed apex.

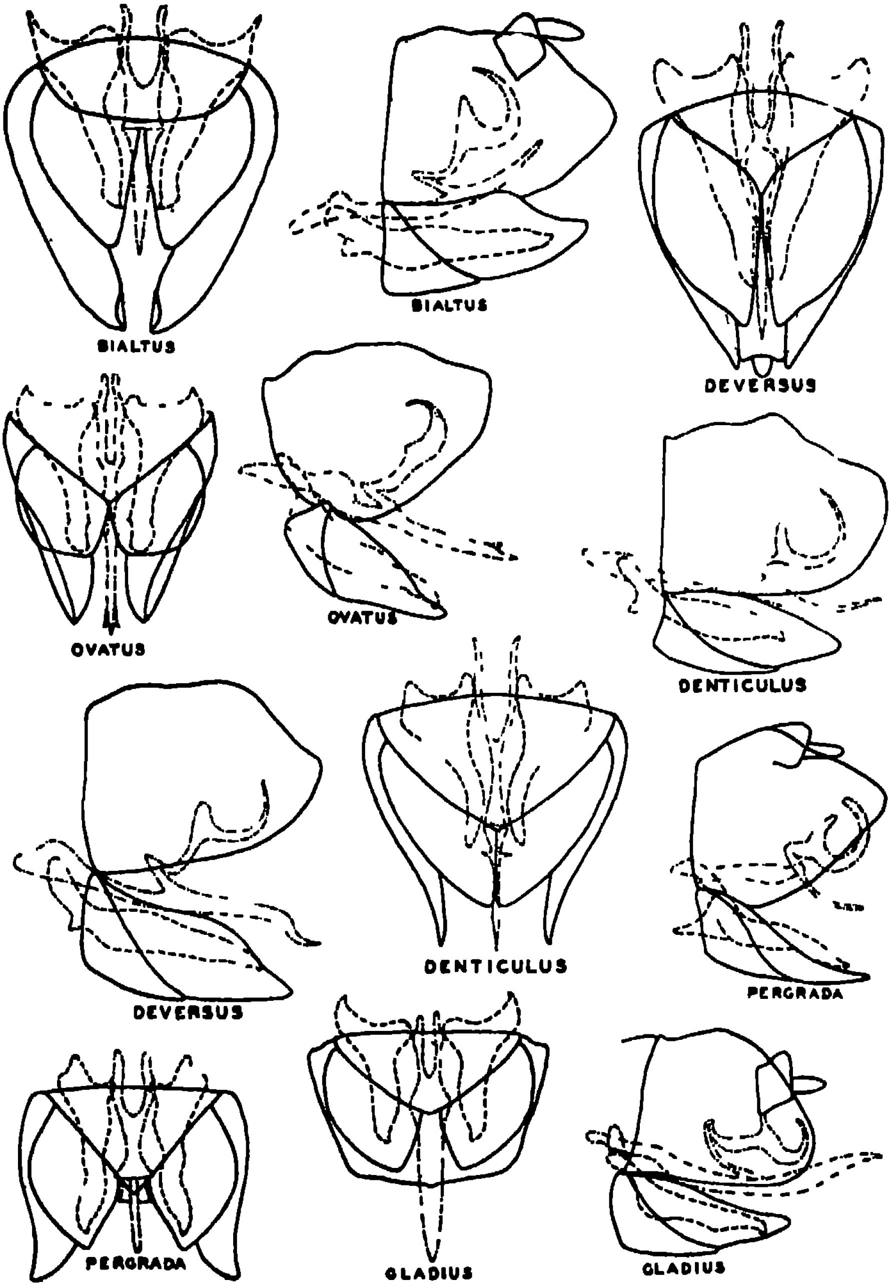
This species was described from material collected in the Davis Mountains of Texas.

Texananus deversus n. sp

In form, appearance and coloration resembling *ovatus* but slightly larger and with distinct genitalia. Length, male, 5 5 mm., female, 5 mm.

Vertex blunt, scarcely angled, more than half as long at middle as basal width between the eyes.

Color Appearing pale brown, gray with ramose brown pigment lines. Vertex with a pale brownish triangular spot just above and either side of apex. A minute black spot just above each ocellus. The basal half of apex rather heavily marked with brownish irrorations. Pronotum



BIALTUS

BIALTUS

DEVERSUS

OVATUS

OVATUS

DENTICULUS

DEVERSUS

DENTICULUS

PERGRADA

PERGRADA

GLADIUS

GLADIUS

Lateral and ventral views of male genitalia of species of *Texananus* as named

rather heavily marked with brown Scutellum pale with three small black dots on central portion, two just back of margin of scutellum Elytra with a pale border along scutellum and a pale commissural lobate area

Genitalia The female seventh sternite short, lateral angles rounded, posterior margin broadly concavely angularly excavated from lateral angles to a short median V-shaped notch which extends almost to the base. Male plates short, two-thirds as broad as long, apices bluntly pointed Styles long and narrow, apices blunt Dorsal portion of aedeagus with terminal portion sickle-shaped curved upward Ventral portion elongated, extending caudally with apex curved downwardly, then apically, narrowed and sharply pointed

Holotype male, allotype female and female paratypes collected at Brownsville, Texas, May 25, 1939, by D J and J N Knull

Texananus denticulatus (Osborn and Lathrop)

Phlepsius denticulatus Osb & Lath Anns. Ent Soc Amer 16 345, 1923

A small species resembling *ovatus*, but smaller Length 4 25 to 4 75 mm

The vertex is distinctly angulate but blunt at apex, nearly twice as long at middle as length next the eyes Dull gray to pale brownish marked with darker brownish irrorations

The female seventh sternite is produced to form blunt but prominent lateral angles The posterior margin is rather deeply roundedly excavated between the lateral angles and the median produced half which is notched so as to form four median produced teeth The outer two are a little longer and more separated than the central pair Male plates short, rather blunt and rounded at apex Style elongate, basal half much broader than the apical half The aedeagus is composed of two portions The ventral part is rather broad at base and gradually tapers to a narrow, pointed caudally directed apex The dorsal portion is sickle-shaped, open upward The basal dorsally directed part is short and thick, the apical portion is narrow and curved

The species was described from specimens from Los Banos California

Texananus gladius DeLong

Texananus gladius DeLong Ohio Jour Sci 38 41, 1938

Closely related to *ovatus* Length 5 mm

The vertex is bluntly angled, two thirds as long on middle as width between the eyes at the base. Color dull yellowish with dark brown markings and with pale commissural line.

The female seventh sternite is broadly, shallowly excavated with a short V shaped notch at the center The male plates are broader than long, broadly rounded The ventral process of the aedeagus in lateral view is blade-like protruding beyond the apex of the abdomen bent upward and narrowed on the apical portion The dorsal portion is connected to the ventral portion by a long narrow strip The dorsal portion is curved twice concavely upward The basal portion is broadly shallowly concave, the apical portion is more deeply concave with a slender apical portion which is curved caudally

This species was described from specimens from Arizona and Texas

Texananus delicatus (Osborn & Lathrop)

Phlepsius delicatus Osb & Lath Anns Ent Soc Amer 16 347, 1923

Resembling *ovatus* in form and general appearance Length 5 mm

The vertex is broadly, bluntly angled The color is pale gray or brown with darker irrorations

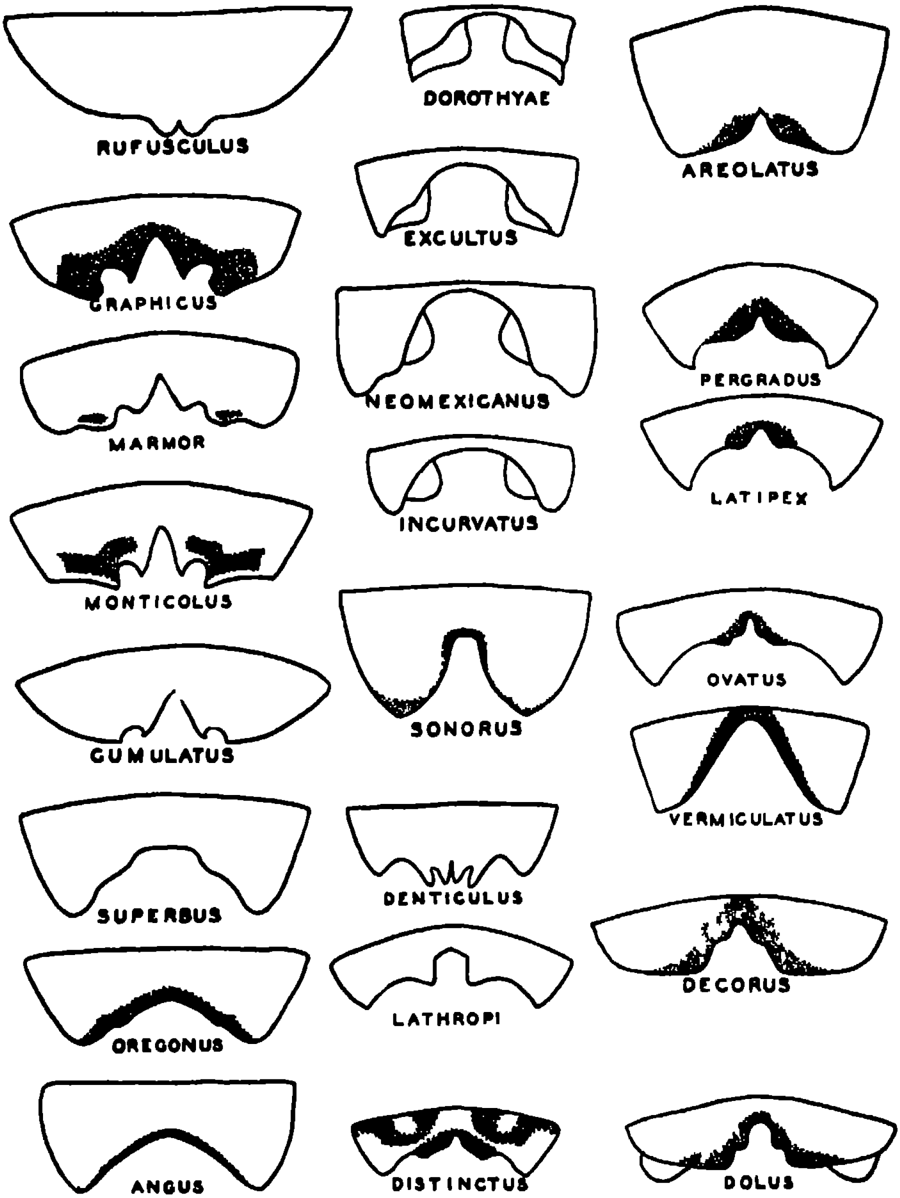
The female seventh sternite is short, the posterior margin is broadly, concavely excavated Lateral angles produced and prominent

This species was described from a single female specimen collected at Palm Springs, California In view of the similarity of the females of this group of small species it has not been possible to definitely determine the identity of the male It is quite probable that *pergradus* is a synonym of *delicatus*

Texananus pergradus DeLong

Texananus pergradus DeL Pan Pac Ent 14 185, 1938

Resembling *ovatus* and closely related to it The ventral process of the aedeagus is slender and unbranched Length 4.5 to 5 5 mm



Seventh sternite of females of species of *Texananus* as named

The vertex is bluntly angled about two-thirds as long at middle as the basal width between the eyes. Color pale brown with darker brown markings. In well marked specimens with a broken brown band between the eyes on the disc. The three pale commissural spots on elytra distinct.

The female seventh sternite with prominent lateral angles between which the posterior margin is rather strongly and broadly excavated, with a short, brown margined, V-shaped notch at apex of excavation Male plates broad and short, together appearing semicircular Styles elongate, broadened at base, constricted near middle with apex bluntly pointed. The ventral portion of the aedeagus is very slender and delicate and is rather short The dorsal portion is sickle-shaped, the base of which is thickened, the apex of which is more slender and strongly curved dorsally and anteriorly

The type specimens of this species are from New Mexico, Texas and Utah Its distribution is through the southwestern states.

Texananus latipex DeLong

Texananus latipex DeLong Bull. Brook Ent. Soc 38 124, 1943

Related to *ovatus* and *lathropi* but with distinct genital structures. Length 6 mm

The vertex is bluntly angled and almost twice as wide between the eyes at the base as its median length The color is pale brown with dark brown markings Elytra heavily marked with dark brown, the three pale commissural spots distinct.

Female seventh sternite with posterior margin rather deeply, broadly excavated between the prominent lateral angles Male plates short with blunt apices The styles are elongate, rather slender, broadened at base, constricted at middle, bluntly pointed at apex The ventral portion of the aedeagus is rather long and slender, tapered to an acute tip Dorsal portion broad at base with a dorsally curved basal process and a long curved sickle-like apical portion which is bifid at apex forming two prominent teeth

This is a rather common and widespread species in the western United States Specimens in the type series are from Arizona, Idaho, and Nevada It has since been reported for California

Texananus lathropi (Baker)

Phlepsius lathropi Baker Phil Jour Sci 27 159, 1925

Phelpsius annulatus Osborn & Lathrop Anns Ent Soc Amer 16 342, 1923 (homonym)

A small species belonging to the *ovatus* group Length 5–5 5 mm

Vertex blunt a little longer on the middle than length next the eyes The vertex, pronotum and scutellum are yellowish with brown irrorations The elytra are white or pale with dark irrorations and dark pigment lines

The female seventh sternite is quite short The lateral angles are prominent, produced, between which the posterior margin is broadly, shallowly excavated with a deep quadrangular excavation more than half way to the base at the middle. The male plates are very short and broad, slightly bluntly produced at the apex Styles rather narrow, slightly enlarged at base Apex appearing notched at middle with a short, blunt, produced tooth on inner margin and a more produced blunt process on outer margin. The basal portion of the aedeagus is straight and rather slender, slightly enlarged at base. The dorsal portion is sickle-shaped with a long basal handle like process

This species was described from Oregon

Texananus marmor (Sanders & DeLong)

Phlepsius marmor Sand & DeL Proc Ent Soc. Wash 25 152, 1923

Resembling *graphicus* in general appearance but more conspicuously marked and easily separated by the shorter broader male styles. Length 5.5–6 mm.

Vertex roundedly produced, two and one-half times as wide as long Elytra short and broad

Color Dirty white, vertex with fuscous mottling near the apex and a pair of darker spots at base near eyes Pronotum with anterior margin marked with dark brown, posterior portion unmarked. Elytra pale with faint markings giving a mottled appearance.

Genitalia Female seventh sternite similar to *graphicus* The lateral angles are more produced and rounded. The posterior margin is angularly excavated on the median half so as to form a median broad V-shaped notch and a smaller rounded notch on either side between this and posterior margin. The male plates are short and broad, bluntly pointed at apex. The styles are short, broad at base and while narrowed are rather broad at apex which is bluntly pointed on the outer margin. The ventral portion of the aedeagus is shorter and more narrowed than *graphicus* The dorsal portion is sickle-shaped with the ventral portion broad or thickened, the apical half slender

This species was described from specimens collected at Onah, Manitoba, July 24, 1919, from *Juniperus horizontalis* It has not been recorded for other localities

Texananus cumulatus (Ball)

Phlepsius cumulatus Ball. Can Ent 32 202, 1900

Phlepsius notatipes Osb & Lath Anns Ent Soc. Amer 16 343, 1923

A very short, broad species with the vertex scarcely longer at middle than at the eyes Length 6–6.5 mm

The color is dark brown or reddish brown due to numerous irrorations and reticulations

The female seventh sternite is roundedly produced from base to a narrow, rather shallow, emargination either side of a broad V-shaped notch which extends half way to base. Male plates broad, short, triangular with bluntly pointed apices, aedeagus with a rather long, slender ventral process and a dorsal process which is rather broad at base, narrowed apically and curved dorsally Pygofers short and with apices bluntly rounded

This species was described from Colorado It has been collected in several of the western states and occurs on bearberry, *Arctostaphylus*, where this plant is growing on sandy areas along the Great Lakes.

Texananus graphicus (Ball)

Phlepsius graphicus Ball Can Ent. 32 201, 1900

Similar to *cumulatus* in general form and appearance. Length 7 mm

Vertex broad, scarcely longer at middle than length next the eyes. Color dull straw yellow with brownish irrorations The pale commissural line on elytra distinct

Female seventh sternite long, lateral margins sloping to posterior margin which is deeply, roundedly excavated either side of a deep V-shaped median notch These form a sharp pointed tooth on each side of notch and a blunt tooth on edge of anterior margin at each side. Male plates short, bluntly pointed on apices Styles long, broad at base, the apical half quite narrow Aedeagus with the ventral portion narrow, blade-like with the apex pointed. The dorsal process narrow at base, thickened on middle half, narrowed on apical third and curved dorsally The pygofer is bluntly angled at apex.

It was described from Colorado and Nebraska

Texananus monticolus DeLong

Texananus monticolus DeLong Bull Brook Ent Soc 38 125, 1943

Related to *cumulatus* but with different genital characters. Length 6 5 mm

Vertex more than twice as wide at base as median length, broadly, bluntly angled. Elytra short and broad Color pale yellowish marked with brown

Female seventh sternite similar to *graphicus* but the lateral angles are more produced. The posterior margin is excavated by three notches The median notch is broadly V-shaped extending more than half way to the base, on either side of which is a rounded notch next posterior margin Male plates strongly convexly rounded, apices blunt and rounded, inner margins straight to the apices. Styles elongate, rather broad, with blunt apices. Aedeagus with the dorsal process elongate, apex narrowed and curved dorsally, enlarged at middle The dorsal portion appears to lie in the concavity of the long slender ventral portion which curves dorsally caudally to the dorsal portion.

Originally described from specimens collected in New Mexico and Utah

A STUDY OF THE PROPORTIONS OF MALE AND FEMALE MOSQUITOES IMMEDIATELY AFTER EMERGENCE

CHARLES OTTO MASTERS,
Western Reserve University,
Cleveland, Ohio

During the recent war, while the author was doing malaria survey work in Assam, India, some problems were studied using culicines which were so extremely abundant A filthy open-sewer flowed directly through the village of Dibrugarh in Upper Assam, and served as the breeding place of millions of adult mosquitoes which swarmed through the huts during the night

Almost all of these were of the species *Culex* (*Culex*) *fatigans* Wiedemann 1828 but a few *Aedes* (*Stegomyia*) *albopictus* Skuse 1894 were collected The question naturally arose as to whether or not the adults emerged in greater numbers during the evening than they did at other times, and what the proportions at various times were of males and females

Because of obvious restrictions during war time, traps could not be set over the breeding places in the village which would have been an ideal method, but instead large numbers of fourth instar larvae and pupae were collected and taken to the laboratory for their emergence Possibly this transfer changed the time when they would have normally emerged and even possibly the sex may have been changed, but records were kept anyway for study Eight hundred sixty (860) adults emerged in the laboratory

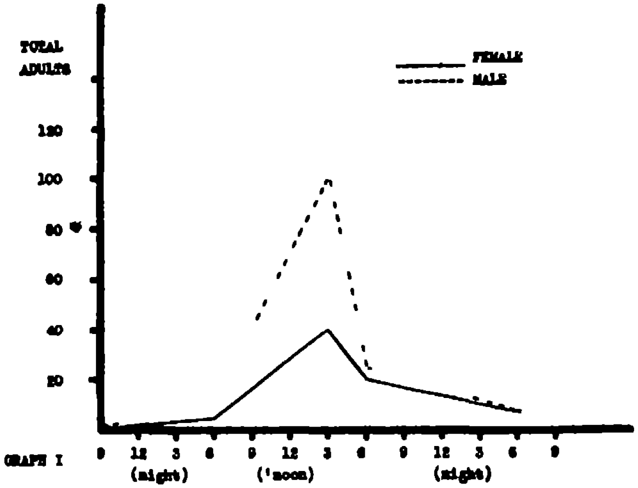


FIG 1 Emergence of adult mosquitoes from collection number one

The larvae and pupae were collected at random along the edge of the sewer and placed in narrow-mouthed litre bottles which were kept in the laboratory where the temperature ranged between seventy and eighty-five degrees Fahrenheit Erlenmeyer flasks were inverted and placed over the mouths of the bottles The adults emerged and rose into the flasks where they remained At regular intervals the flasks were removed and their contents identified

Bottle Number One The first larvae and pupae collected emerged as shown in Fig 1, Graph I within thirty-three hours The largest number emerged during the hours between ten in the morning and two in the afternoon The ratio of males over females was approximately two to one at all hours except at six o'clock in the evening

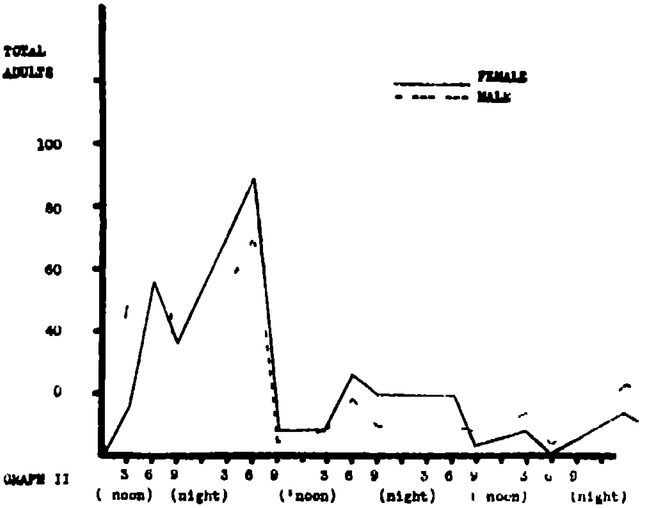


Fig 2 Emergence of adult mosquitoes from collections two three four and five

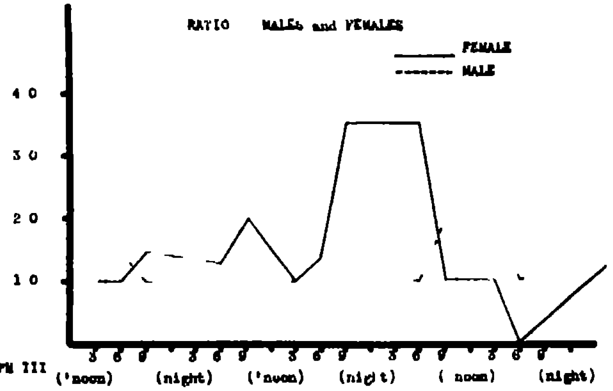


Fig 3 Ratio of male to female mosquitoes at various times during the day

Bottles Number Two, Three, Four, and Five The results of these four were combined because of their similarity The procedures were identical

With the exception of the pulsation of adults which occured six hours after the apparatus was set up, most of the adults emerged during the early evening and night (Fig 2) This was in contrast to the first larvae and pupae collected Possibly the fact that these first ones were collected early in the morning had something to do with their relative early emergence

Of particular interest, however, was the ratio of the males and females at various times during the day As seen by Fig 3, Graph III there was a tendency for the males to outnumber the females during the day but at night the sexes became equal in number or else the females became more abundant

Two years later, in Ohio, the author set up a similar apparatus using a five-gallon bottle Adults were reared from the eggs *Culex territans* Walker, common in local rain barrels, was used The results were as shown by Fig 4

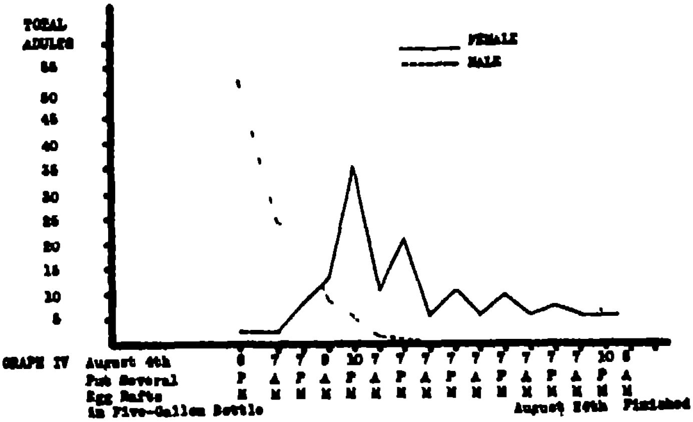


Fig 4 Emergence of adults of *Culex territans*

Conclusions based on so little evidence are of little real value but it was extremely interesting to note that males emerged first during the first four days whereas females continued to emerge throughout the entire week In all, one hundred sixteen males and one hundred twenty-five females emerged

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National Wildlife Federation Announces Nation-Wide $500 Conservation Poster Contest

Again this year the annual national Conservation Poster Contest will be sponsored by the National Wildlife Federation, announced D C Gleeson, Director of the Servicing Division The purpose of the contest is to develop nation wide interest particularly among young people, in the need of restoration and conservation of our natural resources

The Wildlife Poster Contest is open to all students in the United States from the seventh through the twelfth grades in high schools The contest will be divided into two groups with a separate prize for each Group No 1 will cover all contestants in the seventh, eighth, and ninth grades, and the first prize in this category will be $100 00 Group No 2 will cover the high school grades through the senior year, and the first prize for this group will be $250 00 All entries must be received by January 10 1950 All awards will be made in connection with National Wildlife Restoration Week celebrated the first week of Spring in 1950 Other prizes ranging from $100 00 to $10 00 will be presented

The subject of the poster is Soil and Water—and Their Products Entries may be based on a general theme of these basic natural resources and may include Soil Use, Conservation Practices, Forestry, Wild Flowers Plantlife, Animals, Birds, Fish, Water Resources, Pollution, and Flood Control A conservation slogan should appear on the poster with no other printed matter

Last year, over two thousand entries were received from all parts of the United States The winning poster was drawn by Shirley Kabel, a student of Bennett High School in Buffalo, New York.

Rules of the Wildlife Poster Contest may be obtained by writing to the National Wildlife Federation, Washington, D C The poster judges will be announced at a later date

SUMMARY OF LITERATURE ON NUTRIENT MEDIA USED IN CULTURING LIVERWORTS

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During the course of recent investigations into the growth of liverworts, it was found that the information pertaining to the nutrient solutions, which had been used, was widely scattered and often difficult to find. In the following an attempt has been made to give a brief survey of this material in such a way that the composition of the various media may be compared and evaluated. In several instances when the quantities were not given in grams per liter, this data has been added in parentheses in a third column, for the purpose of conformity and comparison. The arrangement is chronological.

Marchal (1906) reported that he had cultured *Cephalozia byssacea* successfully on the following nutrient solution:

$NH_4(NO_3)$	1.00 g
K_2SO_4	0.50
$CaSO_4$	0.50
$MgSO_4$	0.50
K_2HPO_4	0.50
$Fe(SO_4)_3$	0.01
Distilled water	1000.00 ml

Adjusted to pH 7.0 with 10 per cent KOH

Dachnowski (1907) used Knop's solution modified in concentrations of 0.1 per cent to 0.4 per cent, with 0.3 per cent used most often, for culturing *Marchantia polymorpha* in the study of the development of rhizoids and the formation of gemmae. This was made up of the following:

$MgSO_4$	0.0075 g
$Ca(NO_3)_2$	0.0300
K_2HPO_4	0.0075
KCl	0.0036
$FeCl_3$	trace
Distilled water	1000.00 ml

Osterhout (1907) used two nutrient solutions for the culturing of gemmae of *Lunularia* successfully for 200 days,—the duration of the experiment.

Nutrient Solution A

	cc. of 3/32 Molar	
NaCl	1000 cc.	(5.4803 g.)
$MgCl_2$	78	(0.6964 g.)
$MgSO_4$	38	(0.4288 g.)
KCl	22	(0.1638 g.)
$CaCl_2$	10	(0.1040 g.)
Distilled water		(1000 ml.)

On solution A, which was diluted artificial sea water,[2] there was a 1204 per cent increase in the length of the thallus. Another solution (solution B) which he also used gave almost equal results, a 980 per cent increase in the length of the *Lunularia* thallus.

Nutrient Solution B

	cc. of 3/32 Molar	
NaCl	1000 cc.	(5.4803 g.)
KCl	22	(0.1538 g.)
$CaCl_2$	10	(0.1040 g.)
Distilled water		(1000 ml.)

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[1] I wish to express my appreciation to Dr. Margaret Fulford for much helpful criticism in reading the manuscript.

[2] The artificial sea water was prepared from Van t Hoff's formula which has the same constituents but at ⅜ M. strength.

Kilian (1911) reported favorable results using a nutrient solution devised by Marchal for the study of cultures of hepatics This included the following

$NH_4(NO_3)$	1 00 g
$K_2(SO_4)$	0 50
$Mg(SO_4)$	0 50
$Ca(SO_4)$	0 50
$(NH_4)_2PO_4$	0 50
$Fe(SO_4)_3$	0 01
Distilled water	1000 00 ml

Buch (1920) reported good results with a nutrient solution which he had used in a morphological and physiological study of *Sphenolobus Michauxi*, *Pellia epiphylla*, *Blepharozia ciliaris*, and *Cephalozia bicuspidata* It contained the following

K_2HPO_4	0 80 g
$MgSO_4$	0 30
$CaCl_2$	0 30
$FeCl_3$	trace
Distilled water	1000 00 ml

For his studies with the protonema of these species, Buch altered his nutrient solution and made a solid medium with the addition of agar as follows

KNO_3	0 12 per cent	(1 20 g)
K_2HPO_4	0 08	(0 80 g)
$MgSO_4$	0 03	(0 30 g)
$CaCl_2$	0 03	(0 30 g)
Fe_2Cl_6	trace	(trace)
Agar	2 00	(20 0 g)
Distilled water		(1000 ml)

Lilienstern (1927) used both Uspenski's and Detmer's solutions plus two per cent agar for culturing *Marchantia polymorpha* in a morphological and physiological study The composition of these two nutrient solutions is given below

Uspenski Nutrient Solution

KNO_3	0 02500 g
$MgSO_4$	0 02500
$Ca(NO_3)_2$	0 10000
KH_2PO_4	0 02500
K_2CO_3	0 03450
$Fe_2(SO_4)_3$	0 00125
Distilled water	1000 00 ml

pH of nutrient solution 7 6

Detmer Nutrient Solution

$Ca(NO_3)_2$	1 00 g
$MgCl_2$	0 25
$MgSO_4$	0 25
KH_2PO_4	0 25
$FeCl_3$	trace
Distilled water	1000 00 ml

The pH of the solution 6 8

Ehring (1934) used the following four solutions on *Marchantia polymorpha*, *Lunularia cruciata*, and *Riccia fluitans* with success

"a" Nutrient Solution

$NaNO_3$	0 0200 per cent	(0 200 g)
$CaCl_2$ $6H_2O$	0 0100	(0 100 g)
$MgSO_4$ $7H_2O$	0 0100	(0 100 g)
KH_2PO_4	0 0100	(0 100 g)
$FeSO_4$ $7H_2O$	0 0005	(0 005 g)
Distilled water		(1000ml)

(Approximate salt concentration 0 05 per cent)

"β" NUTRIENT SOLUTION

KNO_3	0 010 per cent	(0 10 g)
$CaSO_4 \cdot 2H_2O$	0 020	(0 20 g)
KH_2PO_4	0 020	(0 20 g)
$MgSO_4 \cdot 7H_2O$	0 020	(0 20 g)
Fe_2O_3	0 003	(0 03 g)
Distilled water		(1000 ml)

(Approximate salt concentration 0 07 per cent)

"γ" NUTRIENT SOLUTION

KNO_3	0 1000 per cent	(1 000 g)
$Ca_3(PO_4)_2$	0 0500	(0 500 g)
$MgSO_4 \cdot 7H_2O$	0 0500	(0 500 g)
$FeSO_4 \cdot 7H_2O$	0 0005	(0 005 g)
Distilled water		(1000 ml)

(Approximate salt concentration 0 2 per cent)

"δ" NUTRIENT SOLUTION

NH_4NO_3	0 020 per cent	(0 20 g)
$Ca_3(PO_4)_2$	0 020	(0 20 g)
KCl	0 020	(0 20 g)
$MgSO_4 \cdot 7H_2O$	0 020	(0 20 g)
$FeSO_4 \cdot 7H_2O$	0 002	(0 02 g)
Distilled water		(1000 ml)

(Approximate salt concentration 0 08 per cent)

Muller (1939) reported a nutrient solution used by Lorbeer which is a nutrient agar modification of the one used by Benecke

NH_4NO_3	0 200 g
$CaCl_2$	0 100
KH_2PO_4	0 100
$MgSO_4$	0 100
$FeCl_3 \cdot 3H_2O$	0 005
Agar	15 00
Distilled water	1000 00 ml

Also in the same year, Griggs (1939) reported a nitrogen free solution on which he had cultured *Cephaloziella byssacea* successfully for three years The solution was a modification of one of the three salt nutrient solutions devised by Shive, but with only two-fifths the concentration

KH_2PO_4	1 225 g
$MgSO_4 \cdot 7H_2O$	1 848
$CaSO_4$ (anhydrous)	0 340
iron as ferric phosphate or ferric chloride, or ferric citrate	trace
Distilled water	1000 00 ml

(The pH of the solution was between 5 and 6)

Voth and Hamner (1940) used the following nutrient solution successfully in a physiological study of *Marchantia polymorpha*

$MgSO_4$	0 1204 g
$MgHPO_4 \cdot 3H_2O$	0 1744
$Mg(NO_3)_2 \cdot 6H_2O$	0 2564
$CaSO_4$	0 1722
$CaH_4(PO_4)_2$	0 1261
$Ca(NO_3)_2$	0 2362
K_2SO_4	0 1742
KH_2PO_4	0 2723
KNO_3	0 2022
Trace elements	1 00 ml
$MnSO_4$	0 20 p p m
$Na_2B_4O_7$	0 20 p p m
$ZnCL_2$	0 20 p p m
$FeSO_4$	0 02 p p m

(Osmotic concentration approximately 0 285 atmos)

Since then, we have successfully cultured plants of *Leucolejeunea clypeata*, for five months, on the nutrient solution described by Voth and Hamner above

Voth (1941) later suggested the following nutrient solution as the one best for culturing *Marchantia polymorpha*

	cc of 0 5 Molar	
KNO_3	1 6	(0 0808 g)
$Ca(NO_3)_2$	1 4	(0 1148 g)
$Mg\ (NO_3)_2$	1 2	(0 0890 g)
KH_2PO_4	0 8	(0 0544 g)
$MgSO_4$	1 6	(0 0962 g)
Distilled water		(1000 ml)

Very recently Pràt (1948) has reported cultivation of various hepaticae on the following mineral nutrient agar

NH_4NO_3	0 200 g
$CaCl_2$	0 100
KH_2PO_4	0 100
$MgSO_4\ 7H_2O$	0 100
$FeCl_3\ 6H_2O$	0 005
Agar	8 00
Distilled water	1000 00 ml

Pràt also stated that *Riella* was cultured in erlenmeyer flasks on sand to which the above nutrient solution was added, minus the agar

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REDUCTION OF THE INCIDENCE OF COMPLICATIONS OF PREGNANCY[1]

WYNNE M SILBERNAGEL, M D AND JAMES B PATTERSON M D
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It is obvious that it is impossible to perform a controlled experiment dealing with problems affecting human reproduction In order to arrive at a reasonably accurate incidence of the various complications and abnormalities affecting both the maternal and fetal organism a large number of records must be evaluated Such a study made with a sufficiently large number of consecutive and carefully analyzed case histories has clinical and statistical significance and should serve as an adequate substitute for a controlled experiment

The expected incidence of the various complications of pregnancy is known This report is made from a study of 382 consecutive private patients Each patient was given a daily dose of wheat germ oil concentrate[2] throughout her entire pregnancy Our earlier study (4) prompted this prophylactic approach A significant lowering of the expected incidence of the various complications of pregnancy was observed

This study shows that 30 patients or 7 8 per cent threatened to abort, and of these 16 or 53 3 per cent of those who threatened to abort went to term, and 14 or 46 6 per cent of those who threatened to abort did abort The abortion rate of this series is 3 6 per cent The accepted rate of threatened abortion is between 15 to 25 per cent The actual spontaneous abortion rate in this country is reported to be at least 13 per cent (1), (2), (3), (5)

Our study also reveals a lowering of the expected incidence of toxemias of pregnancy, prematurity, still-births, and neo-natal deaths This last condition is due to the higher survival rate among those babies who are born prematurely

There were no gross abnormalities among either the term or premature babies Among those who aborted only one embryo showed a gross development deficiency

We feel that we have used the wheat germ oil concentrate in a sufficiently large number of consecutive patients to justify the belief that the incidence of the complications of pregnancy may be markedly reduced

PATIENTS STUDIED

Three hundred and eighty-two patients were observed Each was given three 3 minim capsules of wheat germ oil concentrate daily throughout her entire pregnancy If complications arose, the dosage was increased

RESULTS

THREATENED ABORTION

Of this series of 382 patients, 30— 7 8 per cent threatened to abort Only 14—3 6 per cent did abort, and 16 or 4 2 per cent were controlled and were delivered at term No malformed infants were delivered and only one embryo showed a gross development deficiency

A patient classified as having a threatened abortion exhibited vaginal bleeding with or without cramping Bleeding from local lesions was excluded and in all patients the blood serology was negative We made a radical departure from the accepted treatment of threatened abortion None of the patients was put to bed Each patient was permitted to carry on her usual household duties, and her dosage of wheat germ oil concentrate was increased from three capsules daily to twenty capsules daily This dosage was continued until all bleeding had ceased for two days and the dosage of the concentrate was then decreased one capsule daily until she was again taking three capsules per day

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[1] From the Department of Obstetrics, White Cross Hospital

[2] An 8 to 1 concentrate of wheat germ oil made by removing the glycerides and retaining the unsaponifiable fraction The wheat germ oil is extracted from fresh wheat germ with ethylene dichloride by the VioBin Corporation, Monticello, Ill

RH FACTOR

Fifty patients were Rh negative Thirty-eight were multigravida and twelve were primigravida Ten husbands were also Rh negative Only three of these patients threatened to abort, but all three were controlled and delivered at term One mother delivered a baby who developed the toxic form of erythroblastosis and died on the eighth day Her first child was normal but she lost her second child on the third day with the icteric form of erythroblastosis It is interesting that the anti Rh antibody titer of this mother's blood never exceeded 1 64 and dropped to 1 32 just before delivery

Wheat germ oil concentrate may be a factor in the prevention of some cases of erythroblastosis fetalis by lowering the incidence of threatened abortion and thereby preserving the integrity of the syncytial barrier

PREMATURITY

The standards of the American Academy of Pediatrics were used in the classification of the premature infants Twelve mothers had fourteen premature babies, there were two sets of twins Three of these babies were still-born, two due to abruptio placenta, and one due to severe pre-eclampsia in a diabetic mother The corrected percentage of prematurity in this series was 2 8 per cent

Class 1—1000 Gms or less—1 or 7 per cent of prematures
Class 2—1000–1500 Gms —1 or 7 per cent of prematures
Class 3 –1501–2000 Gms —8 or 5 6 per cent of prematures
Class 4—2001–2500 Gms —3 or 2 1 per cent of prematures

Two premature babies succumbed in the neo-natal period One was a class 2 and the other a class 3 premature Of the premature babies born alive, 9 survived The premature survival rate for all classes of premature babies was 82 per cent

The expected incidence of prematurity as reported by Brown et al (5) after a study of 13,399 mothers and infants was 7 per cent Eastman (6) reported the incidence of prematurity in a study of 28 493 deliveries to be 11 7 per cent An analysis of 32,381 consecutive deliveries in Franklin County, Ohio, showed the incidence of prematurity to be 7 1 per cent

It has been shown that bleeding in pregnancy doubles the incidence of prematurity (7), (8) Any agent that will aid in the prevention of uterine bleeding must necessarily be an important factor in saving infant lives Prematurity is the largest single cause of death in the first year of life It is also the only condition of infants which is listed among the first ten causes of death The prevention of prematurity is probably more important than good pediatric care

We believe the figures shown are significant Our incidence of prematurity of 2 8 per cent (corrected) is lower and the survival rate of 82 per cent is higher than that usually reported

TOXEMIAS OF PREGNANCY

Nausea and vomiting of pregnancy occurred in 113 patients or 29 5 per cent of the series This was easily controlled by the intravenous administration of pyridoxine HCL (9) The early correction of nausea and vomiting may have been a factor in the reduction of late toxemias of pregnancy (10) We are unable to determine to what extent the wheat germ oil concentrate was responsible for lowering the incidence of toxemia

The expected incidence of the pregnancy toxemias exclusive of nausea and vomiting is 10 per cent (11). In this series fourteen (3 4 per cent) patients developed some form of toxemia as shown in the table

Nephritic Toxemia	(Group A 1) (a)	1 patient	or 0 2 per cent
Mild pre-eclampsia	(Group B 1) (a)	11 patients	or 2 8 per cent
Severe pre-eclampsia	(Group B 1) (b)	1 patient	or 0 2 per cent
Eclampsia	(Group B 2) (a)	1 patient	or 0 2 per cent

All the mothers survived and one baby was lost, a premature still-born from a non-cooperative diabetic mother

Evaluation of the toxemias of pregnancy in this series of patients shows a definite reduction over the expected incidence

STILL-BIRTHS

The incidence of still-births in Franklin County, Ohio, is 2 3 per cent In our series there were four still-births—an incidence of 1 per cent There was one avoidable still-birth from a non-cooperative diabetic mother This baby was also premature Three still-births were unavoidable—two due to cord accidents and one due to complete abruptio placenta

DISCUSSION

The use of wheat germ oil concentrate in obstetrics is not new Currie (12), Watson (13) and Vogt-Moeller (14) have reported on its value It has been erroneously assumed that the results were due to Vitamin E Because no one has been able to duplicate the results of these workers by the use of either distilled tocopherols or alpha tocopherol acetate, the clear cut results of Currie and Watson have been discredited

The results obtained in this series of patients cannot be attributed to the tocopherols since the average American diet is not deficient in tocopherols There must be a factor or factors other than the tocopherols in wheat germ oil which are of biological significance to the integrity of the reproductive mechanism

Whatever its mode of action, wheat germ oil concentrate obtained by extraction with chlorinated solvents is of value in the reduction of the incidence of complications of pregnancy

SUMMARY

Three hundred and eighty-two consecutive obstetric patients were given wheat germ oil concentrate in an attempt to lower the incidence of the complications of pregnancy

The results of the administration of this substance are given

1 Thirty patients or 7 8 per cent threatened to abort Sixteen of these patients were delivered at term and fourteen aborted In this series the abortion rate was 3 6 per cent

2 The possibility for Rh incompatibility was present in forty patients or 10 4 per cent One patient had an erythroblastotic baby which succumbed No other patient had an increased anti-Rh antibody titer Rh incompatibility was not responsible for any of the cases of early or late abortion, toxemia, prematurity, or still-births

3 The corrected incidence of prematurity in this series was 2 8 per cent The survival rate among the prematures was 82 per cent

4 The incidence of nausea and vomiting of pregnancy was 29 5 per cent This was controlled in every patient by the intravenous administration of pyridoxine HCL

5 Fourteen patients or 3 per cent developed one of the toxemias of pregnancy other than nausea and vomiting This is one-third of the expected incidence All of the mothers survived and one baby was lost

6 The incidence of still-births, avoidable and unavoidable, was 1 per cent.

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The Natural History of Mosquitoes

Mosquitoes occur practically everywhere over the earth and because of their importance as pests and transmitters of disease, a great deal of literature has been published about them Scattered through this literature, dealing largely with their classification, control and disease transmission are numerous observations on their biology Dr Bates has assembled in one book data which deal with the natural history of these insects He has searched carefully and the account is quite complete except for the past several years What he found was carefully analyzed appraised and integrated into this highly informative volume that everyone dealing with mosquitoes will certainly want to read It only needs to be called to their attention

This book is uniformly good each of the twenty chapters contains a wealth of information Several chapter titles are Food Habits of the Adult, Physiology and Behavior of Larvae and Techniques in Mosquito Study An excellent feature of the fine bibliography is that each reference is followed by numbers indicating the pages in Bates' book where the reference was used There are 14 tables 9 line drawings and 16 plates consisting of 30 photographs illustrating larval habitats and mosquito techniques An appendix of mosquito species based on Edward's 1932 list and an index complete the book —*Carl Venard*

The Natural History of Mosquitoes, by Marston Bates xv+379 pages and 16 plates The Macmillan Co New York, 1949 Price $5 00

THREE NEW SPECIES OF CLERIDAE (COLEOPTERA)

JOSEF N KNULL,
The Ohio State University[1]

Phyllobaenus varipunctatus n sp

Fig 1

♀ Robust, light brown head exclusive of epistoma and mouthparts, outer segments of antennae, all but median and basal area of pronotum, all but median and apical areas of elytra all legs with exception of median areas on middle and posterior femora middle and posterior tibiae, dark brown, pro- and metasternum and abdomen dark brown

Head convex, finely, densely punctate, punctures somewhat concealed by light recumbent pubescence, eyes prominent third segment of antennae much longer than wide

Pronotum about as long as wide widest in front of middle, constricted at base and apex, sides rounded in middle, subparallel at base disk convex with wide subapical transverse depression and a much deeper similar depression at base surface finely rugose between fine indistinct punctures, densely pubescent with different length hairs Scutellum small, densely pubescent with light recumbent hairs

Elytra extending to about middle of abdomen, near base wider than widest part of pronotum, sides converging toward obliquely truncate apices serrate each side of truncature, dehiscent on inside, disk flattened apices tumid surface densely coarsely punctured to middle, densely finely punctured at middle rugose from this area to apices an oblique band of light hairs on each elytron, long brown pubescence dense

Abdomen beneath moderately densely pubescent Ungues with a basal tooth

Length 4 5 mm , width 1 4 mm

Holotype ♀ and paratype labeled Brownsville Texas, May 25, 1934, J N Knull collector in collection of author

The color, short elytra and convex pronotum will distinguish this species from other known forms in our fauna

Phyllobaenus stupkai n sp

Fig 3

Slender, elongate, head, prothorax and scutellum black elytra with dark brown area extending forward diagonally from near outer apices to suture in front of middle rest of elytra anteriorly brownish yellow, ventral surface dark brown, mouth parts, antennae and legs brownish yellow

Head convex, punctures indistinct pubescence moderate eyes prominent, third segment of antennae cylindrical, longer than wide

Pronotum slightly wider than long widest in front of middle disk convex with transverse subapical depression and also transverse depression at base, surface smooth, shining in middle, finely rugose toward sides, irregular fine punctures sparse pubescence moderate Scutellum shining, rounded in rear

Elytra wider than widest part of pronotum sides subparallel dehiscent on inside near apices, side margins serrate from near base to subtruncate apices which are entire disk convex, apices slightly tumid, surface opaque, densely, coarsely punctured, densely pubescent

Abdomen slightly longer than elytra, beneath shining, finely punctured pubescence moderate. Legs slender densely pubescent each unguis with broad basal tooth

Length 3 5 mm , width 1 mm

Holotype in collection of author labeled Great Smoky Mountain National Park, Tenn , June 14, 1942, D J & J N Knull collectors Named for Mr Arthur Stupka park naturalist

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[1] Contribution from Department of Zoology and Entomology

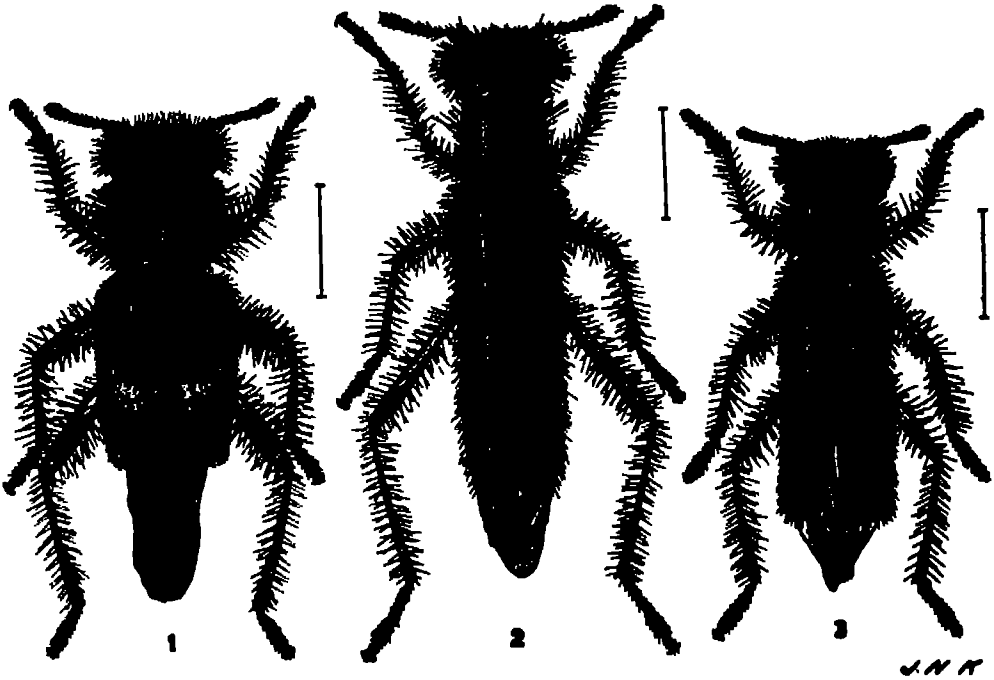
Superficially this species resembles *Isohydnocera schusteri* (Lec.), however the shorter pronotum and toothed tarsal claws will separate it It is same form as *P chapini* (Wolc.) but less shiny, more pubescent elytra as well as markings will distinguish it.

Isohydnocera chiricahuana n. sp

Fig 2

Narrow, elongate, shining, very dark brown with exception of mouth parts, antenna, stripe along lateral margin on each elytron extending from near humerus to near apex, and legs all but area near apex of posterior femora brownish yellow

Head convex surface smooth with well separated minute punctures, pubescence short, eyes prominent, antennae with third segment cylindrical, much longer than wide.



1 *Phyllobaenus varipunctatus* n sp 2 *Isohydnocera chiricahuana* n sp
3 *Phyllobaenus stupkai* n sp
(Line = 1 millimeter)

Pronotum cylindrical, longer than wide, widest in front of middle, disk convex, a transverse depression near apex and at base, surface irregularly punctured, punctures larger than those on head, pubescence upright, moderate Scutellum clothed with light recumbent pubescence.

Elytra at base wider than pronotum, elongate, nearly covering abdomen, sides subparallel, apices separately rounded, serrate, surface convex, densely, coarsely punctured, punctures larger and farther separated toward apices, short upright pubescence intermixed with longer hairs.

Abdomen beneath smooth, moderately pubescent Femora and tibiae slender, with long pubescence. Ungues without teeth

Length 4 5 mm width, 1 2 mm

Holotype and one paratype labeled Chiricahua Mountains, Ariz , Sept 5, 1947, D J & J. N Knull collectors, in collection of author

NECROPHILY VS NECROPHAGY[1]

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"The sanitary officers of the field are legion" (Fabre, 1918)

The aptness of Fabre's statement becomes clearly evident upon examination of carrion found lying exposed in the open field Scarcely has an animal succumbed before it is attacked by scavenger hordes of necrophilous insects, and in a relatively short interval of time it is reduced to an amorphous mat of bones, integument, and vestitures Contrary to the opinion a few years past, however, a majority of the coleopterous insects found in association with carrion are not necrophagous Their presence in and about decomposing flesh is attributable to their predatory habit of feeding on the seething abundance of dipterous larvae and other adult or immature insects for which carrion has attrahent properties

This paucity of exact knowledge concerning the insects inhabiting carrion is probably due to their lack of any great economic importance Only a few species have been studied in detail Members of the family Silphidae have received the most attention, particularly the species of the genus *Necrophorous* Their peculiar habit of burying small dead animal bodies in crypts where the eggs are laid and the young mature with an assured food supply has attracted a number of observers The family Staphylinidae has been almost entirely neglected

The persistent error in entomological literature revolves about a confusion of habits with habitat In his delimitation of the coleopterous habitats Hatch (1925) used the suffix "bious" to indicate the presence of a species in a particular environs without regard to whether or not it procures food in that environment Thus, he designated carrion as a necrobious habitat and categorized the families in accordance with the state of the carrion at the time representatives of those families normally appear The Histeridae, the Staphylinidae, and the Silphidae are found in most abundance around fresh carrion, whereas the Dermestidae and Trogidae are found primarily around dry carrion

With regard to necrobious forms, at least, the epitaph "short-winged scavengers" is not generally applicable to the Staphylinidae (Voris, 1934) Scavengerism has not been observed in many cases for Staphylinids, nor has the eating of carrion flesh in any stage of decay been determined as a regular occurrence Actually, most of the coleopterous insects found in carrion environs are not carrion eaters They are found in a necrobious habitat, hence, are necrophilous. But they are not normally necrophagous

It has been generally assumed that beetles found in association with carrion are necrophagous, and this concept has been passed along in both general and specific references The former group includes such widely used texts as Frost (1942), Folsom (1922), Comstock (1940), and Matheson (1944) The latter is exemplified by the works of Jaques (1915) and Herms (1907), who stated that these coleopterous insects were the responsible agents in getting rid of the quantity of naturally decimated fish washed up on lake shores It seems probable now that the majority of the species they listed are more of a hindrance to the reduction of organic beach debris, since most coleopterous carrion insects actually prey on the necrophagous dipterous larvae found about decay

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[1] Extracted from material presented to the faculty of the Department of Zoology, North Carolina State College of Agriculture and Engineering Raleigh, N C, in partial fulfillment of the degree of Master of Science in Entomology

FOOD HABITS OF CREOPHILUS MAXILLOSUS (LINNE)

Creophilus maxillosus is conspicuously larger than the majority of beetles found around carrion It can be distinguished easily from other beetles approximating its size by its Staphylinid characteristic of abbreviated elytra No other Staphylinids of comparable size are found in such a habitat Small vertebrate carcasses were employed as lures in obtaining specimens for the following observations

Creophilus maxillosus characteristically demonstrates entomophagus predatism Despite its occurrence around carrion, it is not normally necrophagus but preys mainly on the dipterous larvae which mature in decomposing flesh As stated before, this constitutes a departure from the general concept that coleopterous insects found in association with carrion are strictly carrion eaters

Captive specimens also accepted live ants, termites, earthworms, and adult flies, and one was observed attempting to pierce the hard exoskeleton of *Trox suberosus* Just how adept they are at capturing such live prey in the field and how frequently it is attempted was not determined, but evidence seemed to indicate that they might do so whenever such prey was encountered in situations from which escape was not particularly easy On two occasions adult beetles crawling on the outer surface of a carcass were observed attempting attacks on adult Calliphoridae In both instances, however, the flies escaped easily by flight Since the beetles usually enter some aperture of the body and work inside the abdominal or head cavities, it does not seem improbable that they might frequently capture flies entrapped by folds of flesh or viscera in such enclosures

Flies released in the cages where the beetles were captive generally rested on the sides or top of the cages where they were out of reach and remained unmolested When they were rendered semi-immobile by a removal of one or both wings and several legs so that they could neither fly nor take refuge on the sides of the cage they were eventually caught and consumed by the beetles

The beetles indicated no particular concern over the presence of the flies until they chanced to come across them on the bottom of the cage When the flies were disturbed by the passing of a beetle, they buzzed noisily and scooted clumsily about on the substratum The beetles began an immediate attack They rushed forward and seized the bodies of the flies wherever their mandibles first contacted Usually they rolled over on their sides or onto their backs and held the flies before them, firmly grasped in their mesothoracic and metathoracic legs The prothoracic legs were utilized in maneuvering the food toward the mouth parts The crunching of the exoskeleton was clearly audible when the beetles first punctured their prey and began tearing it apart Only the soft inner portions were consumed

The major diet noted in the field as well as in the laboratory consisted of maggots When the maggots were introduced in the cages of specimens which had not been fed for some time, the beetles became obviously excited and began searching about over the surface of the cage with their antennae quivering rapidly This suggested a response to an olfactory stimulus Within a very few minutes the beetles would collect about the supply of maggots and would begin selecting and devouring their prey Often as many as ten or twelve maggots were eaten in rapid succession

The adult beetles also demonstrated a remarkable degree of cannibalism They were quick to pursue and eat the larvae of their own species The smaller first and second instar larvae attempted escape by burrowing into the loose dirt of the cages, but they seldom succeeded in gaining their freedom Only the mature third instar larvae, which attained a maximum length of 25 millimeters, were able to ward off the adults with any degree of success They snapped at the adults ferociously with their mandibles and often discouraged attacks Sometimes two beetles would seize the same larva, pulling and tugging at it until it was torn into two portions or until one succeeded in pulling the larva away from its competitor

All parts of the first two instar larvae were eaten except the head capsules and exoskeletons of the thoraxes The larger third instar larvae were punctured and the internal contents sucked out

In addition to consuming the larvae of their own species, the adults attacked one another They often engaged in fights over the same morsel of food and emerged from such fights with severed antennal segments, tarsi, or entire legs Such fights or repeated battering against the sides of the cages in escape attempts weakened some of the specimens so that they were no longer able to resist the attacks of their companions These hapless individuals were pounced upon by one or more of the other adults and dismembered as were the flies The soft, non-sclerotized portions were eaten This high degree of cannibalism was also noted by Abbott (1937, 1938)

Although the adults most commonly exhibited predatism and cannibalism, they could also be induced to eat carrion in the absence of their preferred food If other food was provided, they fed on various dead animals placed in the cages, for example, small fish, lizards, bits of decomposing rabbits and rats, and small pieces of beef Their liking for such flesh seemed to diminish as the flesh became more decomposed, and they never displayed an immediate enthusiasm for it but only attacked it after a thorough search of the cage yielded food of no other sort They climbed about over the flesh testing it here and there with their mouth parts before selecting a spot into which they would sink their mandibles Rau (1922) determined that the specimens he had in captivity preferred raw to cooked meat but would eat cooked meat to sustain life When bits of flesh infested with maggots were placed in the cages, the beetles consumed the maggots crawling about without attempting to eat the decaying meat Likewise, adults which were busily consuming carrion would abandon it in preference for dipterous larvae introduced nearby

Maggots being consumed by the beetles were seized forcefully in their mandibles which were moved pincerlike until the cuticle of the prey was broken or punctured While feeding, the beetles stood on their mesothoracic and metathoracic legs, using their prothoracic legs to help hold the maggot and to feed it through the mouth parts Once the cuticle was ruptured, the maggot was fed back and forth through the mandibles and maxillae, which squeezed and mashed it until all the soft parts were extracted and nothing remained but the exoskeletal portions If the beetle was a particularly small specimen or the maggot large and vigorous, the position assumed was often like that attained in the struggles with flies, that is, the beetle would roll over on its side or on its back holding the maggot before it In such a position, the prey could not get traction on the substratum, and its struggling was in vain

Examination of the feeding process under a binocular microscope revealed that the beetles secreted a brownish fluid on their food, and portions of exposed flesh on which the beetles had been feeding became discolored and contrasted from their surroundings This suggested an extra-intestinal digestion such as Pukowski (1933) reported for species of *Necrophorous* and a means of partially breaking down the food before ingestion

OBSERVATIONS ON OTHER SPECIES

Clark (1895) recognized that there could be a categorical classification of carrion inhabiting beetles with regard to their food habits and that some species are almost wholly concerned with dipterous larvae encountered in carrion invirons. For example, he classified *Creophilus maxillosus* as primarily a feeder on dipterous larvae Various other observations on carrion species in general have supported this early report Selous (1911) observed that a number of the so-called carrion beetles are not strictly necrophagous at all Davis (1915) noted the species *Silpha surinamensis* and *Creophilus villosus* consuming fly maggots at a dead porcupine carcass Steele (1927) tested a number of species in the genera *Silpha* and *Necrophorous* of the family Silphidae to determine their food preferences. From his laboratory experiments he determined a decided preference for dipterous larvae Other investigators have supplemented and further verified these observations on the Silphidae Excellent summaries of these have been presented by Voris (1934) and Balduf (1935)

SUMMARY

Necrophily is often confused with necrophagy, and many reports indicate that the majority of coleopterous insects found in association with carrion are predatory, feeding on the dipterous larvae common to carrion, and that slightly decomposed carrion is preferred to that which is strongly decomposed *Creophilus maxillosus* demonstrates a high degree of cannibalism, attacking and devouring both mature and immature forms Similar observations have been made on a number of species in the family Silphidae

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NOTES ON THE GENUS BRADYTUS STEPH. AND DESCRIPTIONS OF THREE NEW SPECIES
(CARABIDAE, COLEOPTERA)[1]

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In the treatment of the Tribe *Amarini* by Csiki ('30) the genera *Feronalius* Casey, *Curtonotus* Steph., *Stereocerus* Kirby, *Leironotus* Ganglb., *Leiocnemus* Zimm., *Bradytus* Steph., *Percosia* Zimm., *Celia* Zimm. and *Triaena* Leconte of the Leng Catalogue are reduced to subgenera of *Amara* Bon. All of these are rather well-defined groups of species and easily separated from each other. It would seem simpler to retain them as genera in dealing with our Nearctic fauna. The prothorax wider at the middle than at the base, the comparatively short oval body, the pubescence of the hind tibiae, the prosternal punctured areas and the structure and color of the antennae considered together will separate any species of *Bradytus* from species of other genera that show superficial similarities. No one of the listed characteristics is sufficient in itself to place all species in the proper genus and too great dependence on any one characteristic will lead to misidentification. For example there are two species that have no coarse pubescence on the hind tibiae of the males. There are several species that have no punctured area on the prosternum of the males and in several the prothorax is only slightly wider at the middle than at the base. However when all are considered together there is no question as to placement in the correct genus.

Hayward ('08) lists only six species of the genus. Casey ('18) discusses sixteen species and divides the genus into four groups. Group I (*exaratus*) with four species, Group II (*apricarius*) with one species and Group III (*glacialis*) with three species are adequately treated in Casey's paper and need no further consideration here. Group IV (*latior*) in which Casey placed nine species has been enlarged by the description of three new species by Casey ('24) and by three species that will be described in the pages that follow. Perhaps a key to the fifteen species of the *latior* group will be helpful in recognizing these species. Such a key is difficult to express in brief form because of the close similarities and duplication of structures in this group. A detailed tabulation of the characteristics given in the original descriptions indicates that the species are distinct. All but two of the species have been recognized in collections made in the areas from which they were originally described. *B. relictus* Casey and *B. aequalis* Casey, not yet so found, also seem to be good species as judged by the tabulation. *B. oregonus* Lec., now placed as a synonym of *B. latior* Kby., may be distinct, but since it has not been recognized in western collections and since the original descriptions are very brief and non-committal in certain important respects, it is left as a synonym for the present. *B. aequalis* Casey from Chihuahua, Mexico has been included for comparison and may possibly be found north of the border. A table of all species of Nearctic *Bradytus* and a key to the *latior* group follow.

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[1] Paper No. 44 from the Department of Zoology, Ohio University, Athens, Ohio.

TABLE OF THE NEARCTIC SPECIES OF THE GENUS BRADYTUS STEPH

GROUP I—*exaratus* group
B *gravidus* Casey 18–236
B *curtus* Casey 18–236
B *exaratus* Dejean 28–509
=*furtivus* (Say) 34–420
B *stygialis* Casey 18–237
GROUP II—*apricarius* group
B *apricarius* (Payk) 90–125
GROUP III—*glacialis* group
B *nasnensis* Casey 18–238
B *glacialis* Mann 53–135
B *pulzeysi* Horn 75–129
GROUP IV—*latior* group
B *schwarzi* Hayw '08–42
=*septentrionalis* Lec 48–358
B *latior* Kby 37–36
=*hyperborea* Lec 48–357
laevistriatus Putz 66–262
=*liber* Lec 55–349
=? *oregonus* Lec 55–349

GROUP IV—(Continued)
B *humphreysi* Cay 18–240
B *deceptus* Cay 18–241
B *specularis* Cay 18–241
B *spaldingi* Cay 24–48
B *relictus* Cay 18–242
B *obsolescens* Cay 18–242
B *maxwellianus* Csiki 1930
=*B* *maxwelli* Cay 24–49
B *vegasensis* n sp
B *novellus* n sp
B *neomexicanus* Cay 24–48
B *celianus* n sp
B *aequalis* Cay 18–242 (Mexico)
B *immundus* Cay 18–243

KEY TO THE LATIOR GROUP OF THE GENUS BRADYTUS STEPH

1a	Scutellar stria with an ocellate puncture	*immundus* Cay
1b	Scutellar stria without an ocellate puncture	2
2a	Body narrow and elongate, width approx 3 mm	*schwarzi* Hayw
2b	Body shorter and stouter, width over 3 mm	3
3a	An obtuse carina at the posterior thoracic angles	4
3b	No carina at the posterior thoracic angles	6
4a	Elytral striae fine and very finely punctate lateral series of ocellate punctures narrowly interrupted	*deceptus* Cay
4b	Elytral striae strong, impressed and moderately coarsely punctate lateral series of ocellate punctures widely interrupted	5
5a	Head three-fifths as wide as the thorax Prothorax two-fifths (male) and one-half (female) wider than long Black and highly polished	*latior* Kby
5b	Head less than three-fifths as wide as the prothorax Prothorax one-half wider than long in both sexes Piceous black	*humphreysi* Cay
6a	With an elongate patch of coarse pubescence on the inner side of the hind tibiae of the male	7
6b	Posterior tibiae of the male without such pubescence	14
7a	No scutellar stria no punctured area on prosternum of the male	8
7b	Scutellar stria and punctured area on prosternum of male present	9
8a	Prosternal process between the coxae and the area between the gular sutures of the head distinctly sulcate	*novellus* n sp
8b	Prosternal process and gula not at all sulcate	*vegasensis* n. sp
9a	Size 9 mm and over Inner basal foveae of thorax small, oval and deep with a few punctures, the outer foveae deep, oblique and impunctate	*maxwellianus* Csiki
9b	Size less than 8 mm , basal prothoracic foveae not as above	10
10a	Scutellar stria fine and fragmented prothorax impunctate dorsally	*neomexicanus* Cay
10b	Scutellar stria entire moderate to long Prothorax punctured at least in the basal foveae	11
11a	Prothorax sparsely punctured apically and basally	*relictus* Cay
11b	Prothorax punctured basally only	12
12a	Prothorax sparsely, finely punctate between the basal foveae, scutellar stria long and free	*specularis* Cay
12b	Prothorax punctured in the basal foveae only, scutellar stria moderate	13
13a	Elytral surface finely micro-reticulate, antennae much shorter than the head and thorax	*obsolescens* Cay
13b	Elytral surface polished black antennae almost reaching the base of the thorax,	*spaldingi* Cay
14a	Basal foveae of the prothorax strongly impressed and closely, strongly punctate, elytral striae deep and punctate to behind the middle	*celianus* n. sp
14b	Basal foveae of the prothorax shallow and sparsely punctate, elytral striae impressed but without obvious punctures	*aequalis* Cay

Bradytus novellus n. sp

This insect is oblong-oval in shape and dark piceous black above The under surface is polished dark ferrugineous and the legs, palps, and antennae are entirely ferrugineous. The mandibles are moderately striate on the inner portion of the upper surface the setae on the margin of the labrum are very long, the frontal strioles are short, deep and oblique, and the antennae are about the length of the head and thorax The thorax is very convex slightly wider at the middle than at the base and completely without punctures The anterior and posterior impressions are obsolete and the median stria is very fine, abbreviated anteriorly but reaching the base posteriorly The anterior margin is shallowly arcuately excavate and the anterior angles are bluntly rounded and not prominent The posterior angles are a little more than right, blunt but not rounded The posterior foveae are deep and impunctate the inner foveae are linear and nearly reach the base and the external foveae are oblique The base is margined, obsoletely so medially The elytral striae are fine but rather deep and impunctate with the seventh stria somewhat shallower than the rest The scutellar stria is lacking The intervals are slightly convex, more noticeably near the apex The under surface of the body is impunctate except for a very few obsolete punctures on the anterior part of the meso-sternum The prosternal process has a short sulcus between the coxae and there is a short well impressed sulcus between the gular sutures on the under side of the head There is no punctured area on the prosternum of the male The male front tarsi are dilated as usual in the genus and the hind tibiae have the normal coarse pubescent area on the inner surface.

Length 6 75 to 7 5 mm

Holotype Male Davis Mts (Ft Davis) Texas 9/VII/1911 J W Green, Coll

Allotype Female, same data

Paratypes 11 males, 7 females, same data

I am indebted to Mr J W Green of Easton Pa for turning this series of specimens to me for description 7 male and 5 female paratypes are in his possession and the remainder in the collection of the author at present

Bradytus vegasensis n sp

The body is convex oblong-oval and polished black above and beneath The head is a little over half the width of the thorax, very smooth and impunctate It has shallow linear strioles, eyes moderately convex and antennae and palps ferrugineous throughout The thorax is five-sevenths as long as wide, very convex, widest at about the middle and narrowed very little posteriorly The anterior margin is rather deeply arcuately excavate with the anterior angles bluntly rounded and more prominent than in most other species of the genus. The sides are finely and evenly margined and the posterior margin is transverse with the marginal bead interrupted medially The anterior and posterior transverse impressions are obsolete, the median stria is very fine and abbreviated at both ends, and there is no trace of a carina near the posterior angles. The foveae are small, shallow and impunctate the inner linear and not reaching the base, the outer, short and oblique. The entire thorax is very convex and without trace of punctures on the upper surface. The prosternum is smooth and without the punctured area commonly found on males in this genus. The legs are dark ferrugineous throughout and the front tarsi of the males are dilated moderately as is usual The inner sides of the hind tibiae of the male have the normal coarse pubescence The elytra are convex slightly wider than the thorax, with narrow reflexed margins and a short distinct sinus The stria are complete, distinct, very fine and completely impunctate. The scutellar stria is absent and the lateral series of ocellate punctures is very narrowly interrupted The under surface of the body is impunctate except for a few obsolete punctures on the anterior half of the meso-sternum

Length 7 to 7.5 mm

Holotype Male, 6 mi N E of Las Vegas, New Mexico, 18/V/1946 H F Strohecker, Coll

Female unknown

Paratypes 2 Males, same data

The author is indebted to Dr H F Strohecker of the University of Miami, Coral Gables, Fla. for these specimens One paratype is in the collection of Dr Strohecker, the others, in possession of the author

Bradytus celiaeus n sp

The body is oblong-oval, not strongly inflated polished black above and beneath except that the posterior end of the abdomen and all the legs are rufous The head, exclusive of the eyes, is slightly over one-half the width of the thorax. The eyes are prominent, the frontal strioles are fine, deep and linear The entire antennae are rufous and extend slightly beyond the posterior margin of the thorax The prothorax is five-sevenths as long as wide, widest at the middle, with the sides evenly arcuate and finely reflexed from apex to base The basal angles are slightly greater than right, not rounded and not carinate. The apical margin of the prothorax is evenly arcuately excavate, five-sevenths as wide as the transverse margined base, and the anterior angles are very blunt and rounded Both transverse impressions are obsolete, the apical incised line is broadly interrupted at the middle the median stria is fine and abbreviated anteriorly, and the entire surface is convex, smooth and impunctate except for the basal foveae which are quite deeply impressed and rather closely and deeply punctate Both foveae are rather broad and very similar in size and shape. The space between the outer foveae and the margins is very convex and the area between the inner foveae is impunctate The elytra are slightly wider than the thorax and convex Strial punctures are evident in the anterior half of the first six striae but become obsolete in the posterior half and are missing altogether in the seventh stria The scutellar stria is moderate in length and is punctate The lateral series of ocellate punctures is moderately widely interrupted The intervals are slightly convex on the disk and become strongly so near the apex The prosternum of the male has a small unimpressed oval area with a few very conspicuous punctures, the pro-episterna are impunctate, the mes-episterna are sparsely shallowly punctured and the met-episterna are very obsoletely punctate The front tarsi of the male are moderately dilated and the posterior tibiae of the male are devoid of pubescence on the inner surface This latter trait allies this species with **B aequalis** Casey from which it is very distinct in many other respects however

Length 7 5 mm

Holotype Male, Jemez Mts, New Mexico III/20 Jno Woodgate Collector

Female unknown

This specimen was sent by Mr J W Green of Easton, Pa who recognized it as unusual The type is at present in the author s possession

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THE OHIO JOURNAL OF SCIENCE

VOL XLIX NOVEMBER 1949 No 6

JAPAN AS SEEN BY A FOREIGNER

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Recently Senator McCarran Democrat of Nevada stated among other things If communism takes China completely communism will take all Asia If Japan is denied access to the markets and food supplies of China this nation will be forced to give up its position in Japan not for military reasons but because we can neither feed 85 000 000 Japanese nor provide a market for Japanese industrial production In that event the Japanese people will accept communism rather than starve And the next Communist advance will be into the Philippines If we continue to sit idly by while these events take place we shall have forfeited our world leadership for peace and democracy All our gigantic efforts to rehabilitate Western Europe as a bulwark against communism will have been largely to no avail [1]

This warning illustrates the importance of the area I am about to survey Although I served in the Pacific Military Intelligence Research Section U S Army in 1945 and wrote Japan s Financial authorities published in the Bulletin of the National Tax Association volume XXXI in March 1946 and Japan s Tax Structure published by the International Fiscal Association Amsterdam in July 1947 it does not make me an expert on the subject Therefore I am using such a cautious title But I shall try to add a few facts to clarify the main problems we are confronted with in Japan 1 The geographic problem is how to make use of the strategic advantages of Japan without increasing her military potential 2 The political problem is how to stop communism without encouraging the growth of authoritarianism in any form 3 The economic problem is how to attain economic and financial stability in the long run 4 The main social problem is the annual population increase of two million Japanese without any increase in resources (land capital etc) to take care of them resulting in a tremendous crime wave etc 5 The main military problem is how to provide Japan with self defense against both internal and external foes without nursing a viper endangering S China and the Philippines

All these major problems of course are interrelated and there are many minor problems

1 THE GEOGRAPHIC SITUATION

Japan is that long crescent shaped group of four large islands (Kyūshū Shikokū Honshū Hokkaido) and numerous small islands which lie off the Eastern coast of Asia between 30 and 46 degrees north latitude 130 and 146 degrees east latitude Somewhat south of the north temperate zone it is an excellent location for the development of human energies intensive agriculture and hydroelectric

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[1] *New York Times* April 17 1949 p 34

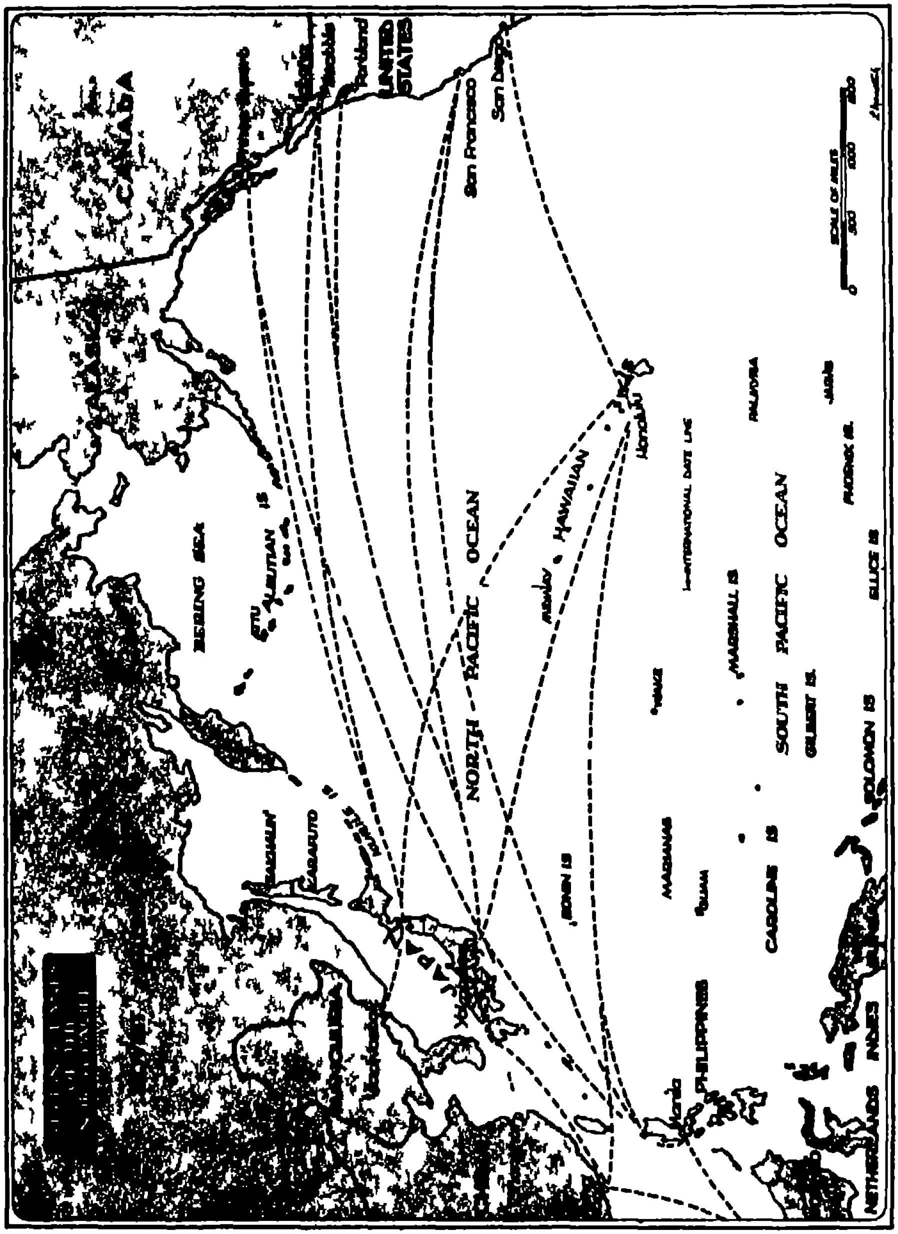

FIG 1 North Pacific shipping lanes

power After World War II Japan lost Korea, Karafuto, Manchuria, etc Now the total land area is 145,000 square miles—about 3½ times that of Ohio But Japan's population of 85 million inhabitants is more than 12 times that of Ohio This overpopulation is a major source of troubles In addition, about 85% of the total area is mountainous (see figure 2) Many peaks, including the famous Fuji, are volcanic and several are active Volcanoes contributed to the formation of deposits of sulphur and abrasives, but also caused losses of life and property Volcanoes, earthquakes, typhoons, and frequent thunderstorms have exercised a profound effect on the Japanese character The people—nervously energetic, often cruel, subjected to hysterical acts of violence, and possessed of a deeply rooted admiration for the man who has the courage to take life, his own or another's—have the profound sense of insecurity that comes from the fact that the earth shakes under their feet and the mountains rain ashes and hot rocks This has helped to make them a very cohesive folk, leaning strongly upon one another, more effective in group action than singly—hence more sensitive to group opinion and receptive to authority To the Japanese the personification of authority is the Emperor (see figure 4), on whom they bestowed divine attributes in the hope or belief that he could give them, his loyal and valuable subjects, some security against unpredictable forces of nature that are themselves the ancient gods of the Japanese and the ancestors of the royal house

Probably Japan's greatest single natural resource is the position of the islands between the principal Asiatic ports and those of North America, and the further peculiarity of the conformation of those islands that places the best harbors on their Pacific coast and gives that coast the most favorable soil and climate Hence this area already had a great concentration of population and a considerable development of both commerce and industry long before the opening of the north Pacific trade route brought the world's ships just offshore

Japan dominates the sea lanes to northern Asia The whole of the Sea of Japan is truly a Japanese lake The Sea of Okhotsk, immediately north of the Sea of Japan and extending above the 68th parallel, likewise became a Japanese lake

The radical curtailment of Japan's naval and air power did not nullify their effectiveness as controls on world trade as long as she has a large industrial population capable of supplying goods and services to the world market Japan will tend to dominate the commerce of the east coast of Asia

Tokyo, Yokohama, Nagoya, Osaka, and Kobe, Japan's five principal port cities, are on the far side of the main island and therefore much more accessible to the world's shipping than would be any of the ports on the continent, and it is easily seen that Japan is in a position to cut off or dominate most of our east coast trade even though shorn of her naval and air power

Strategically the Japanese islands can be considered as one land traversed by two convenient channels for ship traffic, a narrow, very mountainous land bent almost at right angles at 35 degrees north latitude near Tokyo Bay Japan is a land of good harbors Her 17,000 miles of coast line are a continuing succession of coves bays, and estuaries Thus the greater share of her domestic commerce can be cheaply transported by water There are a number of excellent deep-water harbors on the Pacific side, particularly on the lower east-to-west extension of Honshu Yokohama and Tokyo on Tokyo Bay, Nagoya on Atsuta Bay, and Kobe and Osaka on Osaka Bay become natural ports of call for all ships plying the north Pacific shipping lanes (Fig 1)

Then, too, Shikokū Island, the fourth in size, fits snugly in between Kyūshū and the southward-jutting Wakayama peninsula of Honshū Between Shikokū and the westerly extension of Honshū is the narrow island-studded Inland Sea that begins at Osaka Bay and extends westward 300 miles to Shimonoseki Straits There are only three entrances to this all-important waterway and they all are exceedingly narrow, treacherous, and easily defended

Japan's shipping and fishing industries developed in its protected waters in primitive times It was a safe avenue for the interisland commerce that must have played an important part in unifying the nation before the beginning of written history After the establishment of transpacific commerce in the second half of the last century it became even more important because it gave Japan a landlocked passage from Kobe, her greatest shipping port, and Osaka, her greatest industrial city, to the Yellow Sea and the Sea of Japan and the closest route to all the ports of north China, Manchuria, and southern Korea

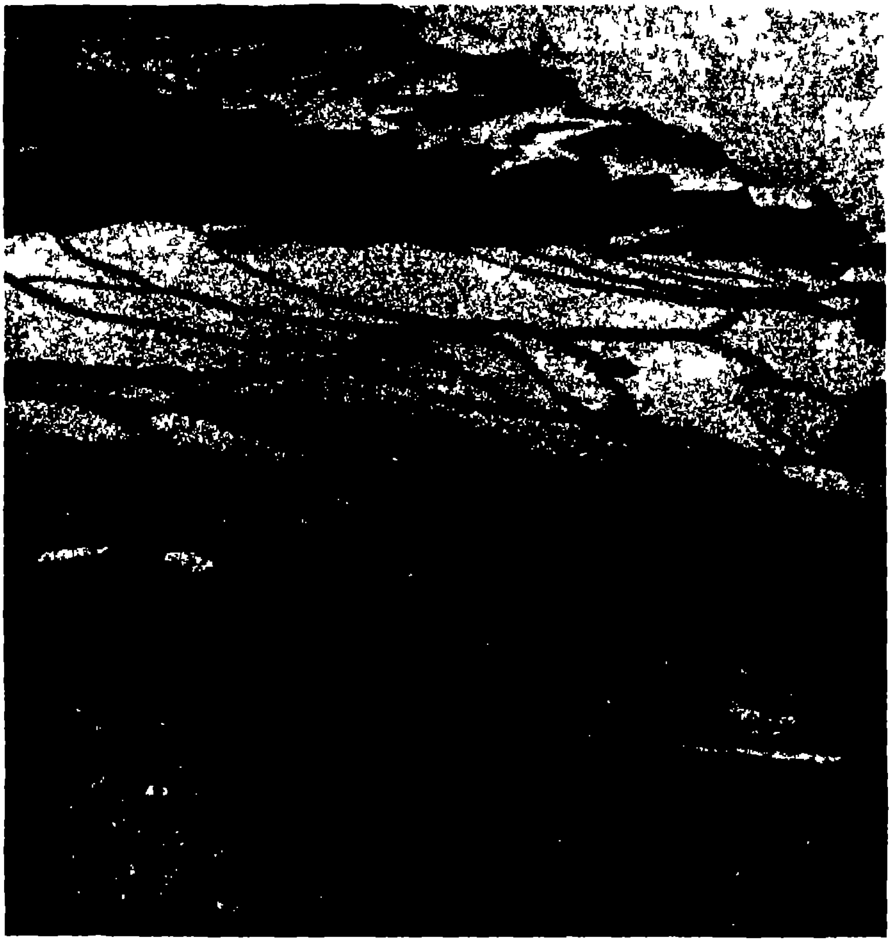

FIG 2 All suitable land is being utilized by the Japanese

The amount and comparative certainty of the rainfall during the growing season, together with the natural water storage in the heavy snow on the still well-timbered mountains, makes possible an enormous production of rice in tiny flooded fields (Fig 2) Japan's food production has been almost sufficient for her own needs, and until recently, it furnished a surplus for export, despite the fact that only about 12 per cent of her total land area can be cultivated (Fig 3)

Her situation gives Japan her exceedingly important fishing industry The seas all around her are exceptionally prolific in marine organisms Offshore fishing was developed early to supply her population with proteins that could not be raised on her restricted agricultural acreage When Japan became industrialized she already had a large number of experienced fishermen who readily adapted themselves to the use of motorized equipment and began harvesting the entire Pacific from the Arctic to the Antarctic as efficiently as a farmer harvests a field of wheat They not only kept Japan's rapidly growing industrial population supplied with the seafood that is such an essential part of its diet but furnished a large exportable surplus that has been an important factor in the country's expanding foreign commerce

It is important to emphasize that Japan's commercial potential has two obvious factors 1 production and 2 the utilization of the Asia-North America trade routes The removal of restrictions that hamper trade over these routes will mean that their use will be vastly increased The Japanese ports will never remain mere way stations on these routes as long as Japan has 85 million highly productive inhabitants That production must be reoriented to fit into a new pattern of world trade based on amity and a free flow of goods rather than one of uneconomic self-sufficiency, the accumulation of military supplies, and the capacity to produce armaments is obvious

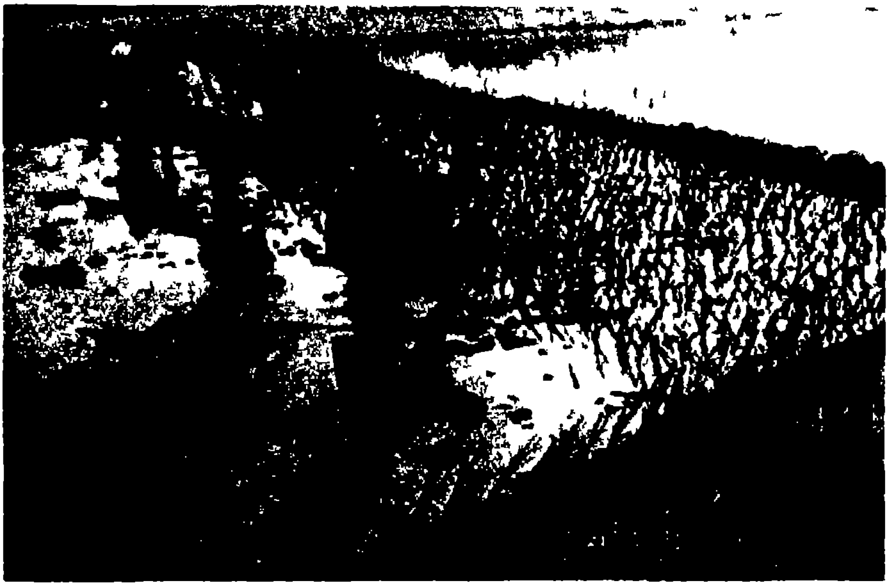

FIG 3 Intensive agriculture is the main occupation in Japan

2 THE POLITICAL SITUATION

The primitive basis of Japanese government is the family council An early unity of all local groups was achieved by the "King of kings," Mikado Jimmu Tenno (550 B C) whose picture is very common (Fig 4) The royal family is in power so long that by the beginning of written history it was already reputed to have had a divine origin Political unity was the only advantage of the Japanese in their long war to dispossess the larger, stronger Ainus The political history of Japan may be divided in six periods

1 555–1005—Japan under the rule of court nobles, naturalizing Chinese culture

2 1085–1550—The feudal period of Samurais and provincial nobles
3 1554–1624—The Christian interlude
4 1603–1868—The Tokugawa era of bureaucratic autocracy
5 1868–1945—The Meiji period and modernization of Japan Copying of alien civilization Persistent, purposeful and ruthless expansion
6 1945– —Occupation period

Throughout this history democracy never existed in Japan and it is difficult to transplant it there now General MacArthur and his staff are doing their best On March 31, 1949, was the 95th anniversary of our 'Open Door" policy established by Commodore Perry in 1854 It went by unnoticed The Japanese greatly admired Commodore Perry secretly (although he ruthlessly frustrated their designs) but sometimes openly disparaged the sentimental collaborationists and appeasers who conducted American affairs in Japan during subsequent periods On April 14 1949, Premier Shigeru Yoshida refused to commit himself before Parliament on whether Japan would remain neutral in the event of a third world war He did so after a heated interchange with Communist deputy Sanzo Nozaka pressing for "permanent neutrality"[2] The present constitution outlaws wars, but seems to be highly unrealistic in view of the ancient military tradition and present conditions there A firm and just administration of Japan by SCAP is absolutely necessary

Prof Carl S Shoup of Columbia University will arrive in Tokyo in late May or June, 1949, for a four-month study[3] to revise the Japanese internal revenue system

3 THE SOCIAL SITUATION

The patriarchic social order of Japan was not changed by SCAP too much But a great amount of social legislation was passed in the last few years (Labor Standards Act, Seamen's Law, Workmen's Compensation Insurance Law, Unemployment Compensation Laws, Employment Security Law, etc)

Shortly after the occupation of Japan by the U S Army, the Supreme Commander for the Allied Powers (SCAP) announced that occupation policy would encourage the growth of trade unions as one means of developing a peaceful and democratic Japan Confirmed by the Far Eastern Commission in December, 1946 this policy was later included in the Japanese constitution, and embodied in a number of laws The National Public Service Law gave all wage and salaried workers employed by the Government the right to organize and engage in collective bargaining, and a number of contracts were concluded between government workers and the administrators of government departments and industries run by the government The law did not deny Government employees the right to strike, but SCAP had full authority to forbid strikes which might endanger the objectives of the occupation

Nearly 40 per cent of organized Japanese labor is employed by the Government, at the end of July, 1948, 2,500,000 out of Japan's 6,700,000 organized workers were members of Government unions In contrast with conditions in the United States, about three-fourths of these Government employees were engaged in industrial or other activities not usually considered as part of central Government administration, nearly 850,000 were railroad workers, nearly 350,000 worked in communications, more than 500,000 were in the educational system In addition, Government workers were employed in coal mines, in the merchant marine, and in the tobacco, camphor and salt monopolies

The spring and summer of 1948 were marked by a series of strikes over wage disputes in the railroad and communications systems (radio, telephone and telegraph) which aroused fears as to possible future interference with public services essential to the Government and the occupation At that time the union of communications workers was Communist-dominated, there was Communist influence in the railroad union but anti-Communists had gained control

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[2] *Toledo Blade*, April 15, 1949

[3] *New York Times*, April 17 1949

In July, after receiving a letter from SCAP, in regard to the trade-union activities of public service employees, the Japanese Cabinet issued Order No 201 This Order outlawed acts of dispute by public service workers, revoked the right to collective bargaining, abrogated existing collective bargaining agreements, and threatened with jail and fines, anyone violating the terms of the ordinance The labor unions claimed that these restrictive measures violated the trade-union principles laid down by the Far Eastern Commission, SCAP stated that these principles did not apply to Government workers

FIG 4 Mikado Jimmu Tenno, God Emperor center of all Japanese philosophy and life

Under laws consequently enacted in December, 1948, all public service workers were to be subject to the revised National Public Service Law until April 1, 1949, except that provincial public workers, i e , employees of prefectural and municipal governments were to remain under the jurisdiction of Cabinet Order No 201 until other legislation is passed However, on April 1, 1949, a new Public Corporations

Labor Relations Law started to govern the labor relations of employees of the public monopolies—tobacco, salt, crude camphor, and camphor oil—and of the railroads Communication workers are among the Government employees who remain under the amended National Public Service Law The revisions of the National Public Service Law caused considerable unrest among Japanese labor groups as well as considerable criticism in the United States Differences of opinion as to the new policy regarding government employees resulted in the resignation of James Killen, the U S Labor Advisor to SCAP Both the AFL and the CIO conventions passed resolutions censuring the actions taken in Japan [4]

Union membership in Japan increased slowly during 1947 and 1948 compared with the very rapid growth in earlier phases of the occupation According to the September "Summation" issued by SCAP, labor unions numbered 23,270 with a membership of 5,724,851 The Japanese Labor Ministry reported 25,896 unions with a membership of 5,926,986, and added the following figures for some major industrial groupings

	Unions	*Members*
Mining and manufacturing	12,792	2 702,144
Governmental and 'free occupations	5,187	1,013 479
Transportation	3,635	1 203 196

There are 4,273 collective agreements covering 8,585 unions with a membership of 5,053,297

Communism has made gains in Japan in the last year and a half in coal mining and electrical workers' unions [5]

Japan is highly overpopulated which causes social unrest The comparison between Japan and France on Chart 2 illustrates the gravity of the situation The overpopulation is also responsible for the present crime wave The Legal Affairs Committee on the Diet's House of Representatives reported on April 5, 1949, "Last year juvenile crimes amounted to roughly 250,000 out of a total of 520,000 recorded criminal offenses On the basis of the 1948 informal census, one boy or girl out of every 100 is a convicted delinquent These youths should be given honest work to do and instead of building more homes and asylums we should build factories and workshops where these boys and girls can work "[6]

Such endeavor should be encouraged by SCAP The Japanese need work, land, and markets for the ever increasing population, if we are to prevent social unrest The best way to stop Communism is to make Democracy work

4 The Economic Situation

The Japanese economy consists of 50 3% agriculture and fishing, 19 7% mining and manufacturing, 20 2% commerce, 7% public services and occupations and 2 8% domestic work [7]

Agriculture still is Japan's most important industry both in capital invested and in net output There is an enormous burden of taxation on farmers They are greatly in debt Most of the subsidies granted favored industries are paid by agriculture There is a decline in soil fertility and increasing use of expensive chemical fertilizers The silkworm raising and charcoal burning are deteriorating

Half of Japan's 16,000,000 arable acres are used for rice plantation Second in importance is barley Other agricultural commodities raised by Japan are wheat, rye, tobacco, tea, soybeans, fruits, pyrethrum, peppermint, camphor, and garden vegetables

The most important animal industries are sericulture, coast and deep-sea fishing, and lifestock production

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[4] *Labor Abroad*, February 1949, No 10, p 64

[5] *New York Times*, April 10, 1949

[6] *New York Times* April 17, 1949, p 32

[7] Japan's Wirtchaft im Spiegel der Statistik, Dr Georg Zimmermann, Berlin, 1941, p 216

Japan mines coal, copper, gold, iron pyrites, petroleum, silver, zinc, sulphur, lead, aluminum, manganese, and magnesium It is important to us because Russia cut off her supply of manganese to us in retaliation to the North Atlantic Pact

Japanese commerce would need a merchant marine of 1 million tons to handle the normal peacetime inter-island and coastal traffic, and 2½ million tons to transport goods to and from the adjacent coast of Asia This traffic is absolutely vital to her industry Japan would also need an internal air transportation system to supplement the 15,000 miles of railroad tracks, canals, and motor transportation Because of World War II, Japan's foreign trade is way below the pre-war average of 3 6% of the world's foreign commerce Japan has to have foreign markets in order to feed her growing population

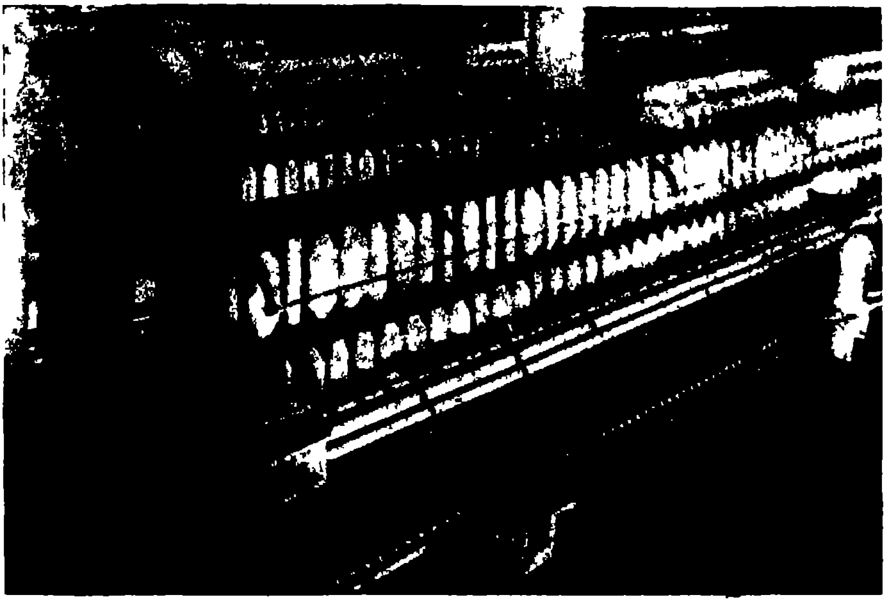

Fig 5 The most modern textile machines in Japan

With regard to Japanese manufacturing, the textile industry occupies first place (Fig 5) Output of textiles is valued at one-third of Japan's total output The heavy industries, largely the result of Japan's urge for industrial self-sufficiency in the production of arms, is largely uneconomic It had to be heavily subsidized Japan produces industrial machinery, engines and motors, prime movers, marine engines, Diesel engines, electric motors and generators, machine tools, railroad equipment, airplanes, automobiles and bicycles[8]

The chemical industry is of increasing importance, especially the production of synthetic petroleum, dyestuffs, cosmetics, drugs, glass, glassware, and rubber goods Chart No 3 shows the organization of the methanol production in Japan

The production of foodstuffs, clay products and wood products is steadily increasing Japan is self-sufficient in cement production The production of newspapers, periodicals and books is relatively more important in Japan than in the U S The motion picture industry emphasizes traditional tales Table I indicates the trends in production from 1930 to 1948

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[8] Japan Its Resources and Industries, Clayton D Carus and C L McNichols, Harper & Bros, 1944 pp 231–232

Industries which increase the military potential of Japan should be curtailed Reconstruction of such industries, destroyed or damaged in World War II, may again backfire The key to the maintenance of Japan is production The primary responsibility for bringing about the required sharp increase in production must of necessity rest with the people of Japan No action by the United States of itself could bring this about

TABLE I

KEY PRODUCTION TRENDS IN JAPAN, 1930–1948

(Monthly averages)

Item	1930–34 Average	Peak	1945	1947	1948 First Quarter	1948 as % of 1930–34	1948 as % of Peak Year
Coal (1 000 metric tons)	2 597	4 777 (40)	4,111	2,270	2,825	108	59
Pig Iron (1 000 metric tons)	104	353 ('41)	42	30	39	37	11
Crude steel (1,000 metric tons)	227	652 (43)	89	78	97	43	14
Raw silk (bales of 132 lbs)	59 840	62 838 (34)	7 768	9,292	8 572	14	13
Cotton yarn (1 000 lbs)	96 497	132,207 (37)	4 933	22,434	21 803	21	16
Rayon yarn & staple (1,000 lbs)	6 888	44 986 (39)	2 293	2 967	3 891	56	8
Ammonium sulphate (metric tons)	34,733	103,500 (41)	20 250	60 082	58,103	167	56
Electric power* (millions of kwh)	1,308	2,857 ('44)	2 715	2,468	2,299	175	80
Cement (1 000 metric tons)	308	500 (40)	98	103	107	34	21
Crude oil (kiloliters)	21 645	32 049 (37)	19,947	16 821	15 193	70	47

*Data for 1930–44 represent output of all utilities, while later data represent 95% of all public utility generation

SOURCE "Japanese Economic Statistics Bulletin No 20 April 1948, Research and Statistics Division SCAP-GHQ, Tokyo

Economic cooperation of America is needed to accomplish two things

1 Help in the rebuilding and development necessary to reknit the economic fabric of Japan and to increase the level of production so that further relief will not be needed

2 Relief and financial aid to tide Japan over its present distress and allow it time to accomplish the necessary expansion of production

The destruction of Japan's industries is the most obvious of Japan's misfortunes Not all of the destruction was done by bombs, the worst damage was done by the Japanese to themselves under the pressure of blockade By 1944, Japan was desperately short of three things it couldn't do without—oil, bauxite, and iron ore The worst case was oil, the shortage of ore was nearly as serious By 1944 the much publicized stockpiles of steel scrap (the Japanese had accumulated about 250,000,000 tons by 1941)[9] had been nearly exhausted The government launched a frenzied scrap drive The greatest victim of the drive was the cotton-textile industry Of 13,000,000 spindles before the war, only about 2,800,000 were operable at Japan's surrender Japan had 450 full-fashionedhosiery machines, all but 50 were broken up, though each machine cost about $15,000 and yielded only 15 tons of scrap, worth about $250[10]

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[9] "Japan s Road Back, ' *Fortune*, Vol XXXIII, No 3, March, 1946, p 125

5 THE FINANCIAL SITUATION

Money, at the end of the war, was plentiful Notes outstanding of the Bank of Japan increased from 5 9 billion Yen at the end of 1941 to 42 3 billion Yen at the end of August, 1945, and were approaching 56 billion Yen at the end of 1945 Prices were held stable in a white market by price fixing and rationing while bushels of surplus money went shopping in the black market By Bank of Japan estimate, the black market price of rice in October, 1945, was 47 times the official price, vegetable prices were nearly 10 times, sugar, sauce, and salt were 52 times[11]

A huge excess of money and liquid claims over salable assets is commonplace in the financial wreckage left by the war Prodded by General MacArthur's headquarters, the Japanese Government pared down some of the excess liquidity with a walloping capital levy running up to 70% In addition, a 100% tax was applied to all war profits earned since Japan went to war[12]

Another big financial operation accomplished for the Japanese economy was the excision of the Zaibatsu, the handful of huge family trusts that owned or controlled a good two-thirds of everything in Japan (Mitsui, Mitsubishi, Sumitomo, Yasuda, Iwasaki)

The Government was also ordered to stop all financial assistance to the cult of State Shintoism, which every Japanese previously had to embrace in addition to his personal religious beliefs It also has to balance its annual budget

Japan has lost as a result of the war 47% of her former territory while the population, within the reduced area, has witnessed an increase of 13 million since the surrender Industrial production has declined 77% Even in total production, there has occurred a decrease of 40%[13] It is impossible, under such circumstances, to stabilize the Japanese economy without the aid of foreign capital In spite of the strenuous effort for economic recovery, industrial production lags behind expectation because of uncertainties of the future, instable exchange rates ($1 = 14–320 yen), lack of capital and the unknown burden of reparations

The Board of Directors of the Export-Import Bank of Japan on April 21, 1948, authorized participation to the extent of 29 million dollars by the Bank with a group of commercial banks in a $60 million revolving credit in favor of the Occupied Japan Export-Import Revolving Fund to finance purchase and exportation to Japan of U S cotton, including cotton linters and waste This Fund was established by SCAP for the purpose of providing a credit base and a means for financing primarily on a self-liquidating basis, Japanese imports and exports of commodities and services required for the achievement of the objectives and policies of our Occupation Accordingly, SCAP transferred to the Fund approximately $104,000,000 worth of gold, silver valued at $18,000,000, and cash $378 000 Thereby we are subsidizing Japan's foreign trade This help, though great, is not adequate to achieve financial stability and to sustain 85,000,000 Japanese in their poorly-endowed islands

6 THE MILITARY SITUATION

On August 14, 1945, General MacArthur was designated Supreme Commander by the nine nations at war with Japan (Australia, Canada, China, France, Netherlands, New Zealand, U S S R , U K , and U S) and accepted the unconditional surrender of Japan Occupation forces which first went ashore were U S troops and the policy directives under which General MacArthur began enforcing Japanese fulfillment of the surrender terms were issued by the U S Government on August 29, 1945 The policy document was the product of a coordination of efforts among the State, War, and Navy Departments recognizing that in the postwar period U S foreign policy and U S military policy must function as one, as national policy

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[10] *Ibid*

[11] "Japan's Road Back," *Fortune* Vol XXXIII No 3, March 1946, p 128

[12] "The U S Does a Job, *Fortune* Vol XXXV, No 3, March, 1947, p 134

[13] "The Birth of the New Japan, ' *Education*, Nov 1948, p 171

In Tokyo, SCAP works closely with the Allied Council for Japan (ACJ) which is composed of SCAP or his deputy as chairman and U S member, one representative from the Soviet Union, one from China, and one representing jointly Great Britain, Australia, New Zealand and India To carry out the job of occupation, SCAP has a carefully planned and specially staffed organization composed of staff sections controlling virtually every phase of life in Japan SCAP closed 159 institutions with assets of 209 billion yen Liquidation proceeds have been 8 8 billion yen and payments of domestic claims 7 4 billion yen[14] SCAP is demilitarizing Japan The Japanese people seem united in opposing war Their determination is based not only on the formal pledge to renounce the right to belligerancy as set forth in the new constitution, but on their hatred and disillusionment with regard to the past militarism

Strong opposition is being voiced by China and the Philippines to the U S plan to assist and promote Japan's recovery It is based on the apprehension that an economically strong Japan would again prove to be a menace to them But General MacArthur never envisaged any plan for American assistance to Japan at the expense of China or other Asiatic countries The recent change in American policy toward Japan in assisting her recovery has given new hope to the Japanese people But real recovery for Japan waits upon the formulation of a comprehensive and coordinated program for the revival of all Far Eastern countries along the lines which the United States has been pursuing in Europe, i e , a PACIFIC SECURITY PACT, tieing together all countries opposed to aggression from Alaska to New Zealand

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[14] "Two Years of Occupation, SCAP HGQ August 1947, p 10

A CLIMATIC STUDY LEXINGTON, KENTUCKY

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Lexington, administrative center of Fayette County, is located 80 miles south of Cincinnati, 75 miles southeast of Louisville and 55 miles northeast of the geographic center of the state. It is situated in the heart of the Bluegrass region and lies at an elevation of approximately 1,000 feet above sea level. The surface of the county is mildly karst and gently rolling with a maximum relief of 200 feet. Eastward the relief becomes more pronounced and at a distance of 50 miles the westward-facing edge of the Cumberland Plateau is reached.

The Bluegrass region was one of several sections west of the Appalachians settled and developed at an early date. The first settlers came mainly by way of the Wilderness Trail which ran through the Cumberland Gap. Interest was directed not only to the excellent forests, fertile soils, and choice crop lands, but to the region's climate as well. Some of the climatic records for Lexington date back to 1828. The early records, however, were fragmentary and were not continuous.

Professor Thomas J. Mathews of Transylvania University, Lexington, Kentucky, kept the records during the year of 1828 and part of 1829. In the years 1835-1838, Dr. L. P. Gandell and Dr. Robert Peter, both of Transylvania University made observations of temperature, rainfall, and barometric pressure. A report was made to the College of Physicians and Surgeons and an article appeared in the *Transylvania Journal of Medicine*, entitled "Notices of the Weather and Diseases of 1835." No further records are available until the year of 1858 and from that date to the present, records are complete with the exception of the years 1876-1879 inclusive. Beginning with the year 1858 records were kept by Mr. H. F. Hillenmeyer of the Hillenmeyer Nurseries, located three miles north of Lexington. These records have been continued by Mr. Hillenmeyer's sons, Ernest, Louis, and Walter, throughout the years.

In 1872 the Signal Corps of the United States Army opened a weather observatory at State College, later known as the University of Kentucky, but no information is available to explain the reasons for this office being closed between 1876-1879. Beginning with the summer of 1879 and continuing through 1887 their records were kept at the Hillenmeyer Nursery. In 1887 an office was re-established by the Signal Corps in downtown Lexington, but within a year was moved back to the College grounds. The reasons for the removal are not clearly set forth in the records, but in contemporary reports it appears that the press gave little encouragement to the publication of the forecasts and reports, and only a jealousy toward Louisville made sufficient excuse locally for the maintenance of the observatory. A desire by the Experiment Station for records in connection with its agricultural activities seems to be given as one argument for connecting the service with the College. The collecting of climatic data was under the direction of Professor V. E. Munsey for a period of 10 years, but late in 1898 the work was once more undertaken by a regular Weather Bureau official at the expense of the government. As the College grew to the capacity of a University, the Weather Bureau office was increased in equipment and personnel to meet any demands that the University might make of it in an educational way. During the summer of 1908, Mr. C. H. Noyes was placed in charge of the observatory with the rank of Local Forecaster.

In the summer of 1915 the location of the observatory was again changed to a downtown office occasioned by a rising demand on the part of business for the services of the Weather Bureau, a demand which seemed to overshadow the university requirements. Mr. George B. Wurtz became the official in charge and continued in this capacity until his retirement in 1933 Mrs E S Kinkead took over the work at this time and continued to keep the records until 1944 when the office was transferred to its present location at the Bluegrass Airport, 5 miles west of Lexington, under the direction of the United States Weather Bureau

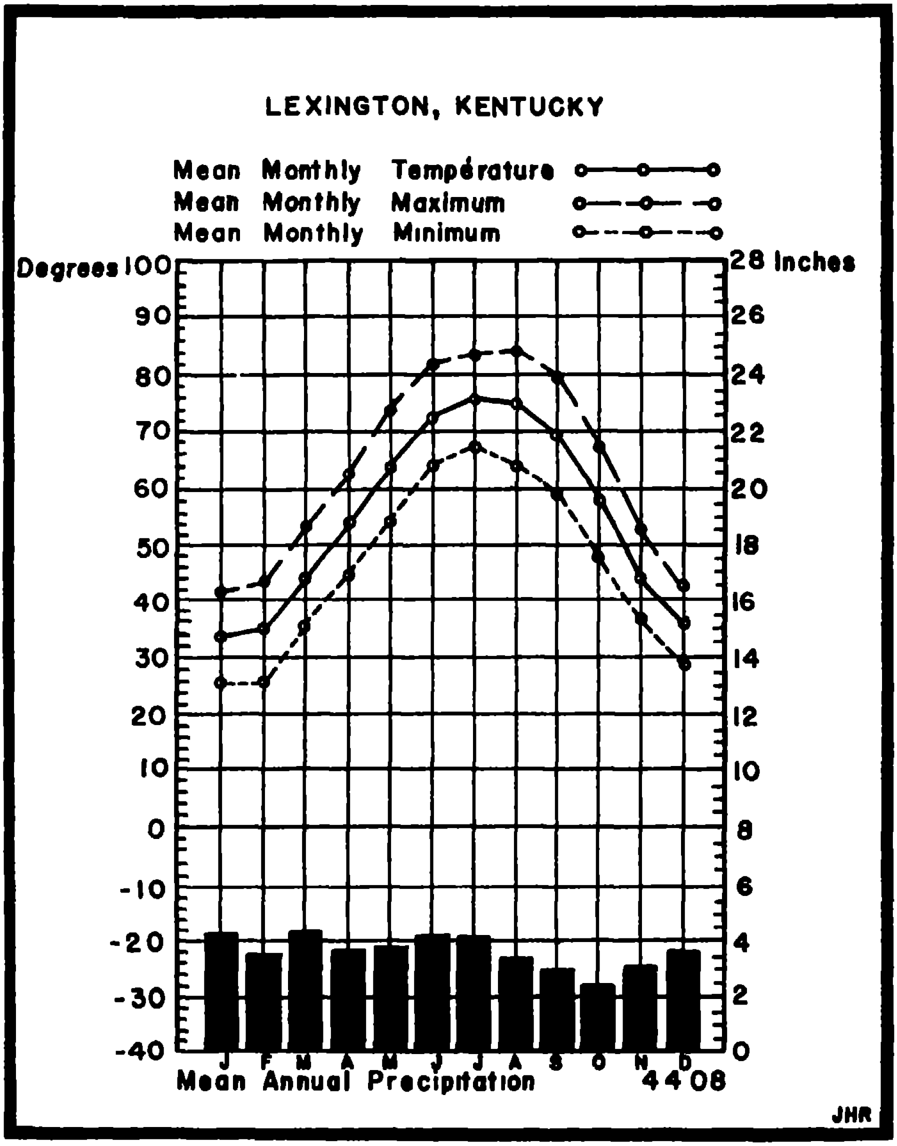

FIGURE 1

Lexington and eastern Kentucky lie within or near the path of moisture bearing cyclonic storms which move from the Gulf region, northeastward over the Mississippi and Ohio Valley regions Convectional activity which varies greatly in frequency, character, and force is another factor in the summer weather of this region

Table I and Fig 1 present a summary of various precipitation and temperature data The mean monthly precipitation varies from a maximum of 4 33 inches in March to a minimum of 2 45 inches in October The mean annual precipitation is 44 08 inches Almost 23 inches of this total, or a little over one-half, falls during the colder half of the year (November to April inclusive) The distribution of precipitation during the seasons is as follows spring,[1] 11 88 inches, summer, 11 85 inches, autumn, 8 67 inches, and winter, 11 68 inches This shows that the spring, summer, and winter seasons receive nearly a quarter more precipitation than the autumn months

TABLE I

PRECIPITATION AND TEMPERATURE AT LEXINGTON AVERAGES AND EXTREMES
(Length of Record 62 Years)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Average precipitation	4 27	3 68	4 33	3 75	3 80	4 21	4 15	3 49	3 01	2 45	3 21	3 73	44 08
Average number of days with 0 01 inch or more precipitation	14	12	13	12	12	12	11	10	8	8	10	12	134
Average temperature	33 7	34 9	43 9	53 9	64 1	72 9	76 2	74 8	69 5	57 3	44 7	35 8	55 1
Average of the maximum temperature	41 6	43 1	53 1	63 6	73 8	82 5	84 1	84 3	70 4	67 3	53 2	43 3	64 2
Average of the minimum temperature	20 6	26 7	34 7	44 0	54 3	63 4	66 6	63 [illegible]	59 3	47 4	36 2	28 4	46 0
Absolute maximum temperature	80	75	86	91	96	104	108	102	101	93	80	71	108
Absolute minimum temperature	15	20	1	15	30	40	47	46	32	21	3	9	- 20
Highest monthly average temperature	50 9	53 4	65 0	71 7	83 4	91 2	94 0	95 0	90 6	75 7	62 [illegible]	58 4	68 8
Lowest monthly average temperature	12 0	15 6	27 6	36 9	47 7	59 3	63 3	61 4	52 3	40 4	29 5	17 5	43 1

TABLE II

DRIEST AND WETTEST MONTHS AND YEAR OF OCCURRENCE AT LEXINGTON

	Driest Month	Year	Wettest Month	Year	Normal
January	0 77	1931	15 10	1937	4 27
February	0 52	1895	11 06	1883	3 68
March	0 46	1910	9 91	1890	4 33
April	0 40	1896	7 30	1872	3 75
May	0 65	1932	11 03	1882	3 80
June	1 05	1864	10 62	1928	4 20
July	0 45	1930	11 24	1875	4 14
August	0 62	1875	8 96	1932	3 48
September	0 33	1895	8 63	1868	3 01
October	0 11	1924	7 95	1919	2 45
November	0 53	1904	8 50	1919	3 21
December	0 80	1925	9 02	1865	3 73
Annual	24 89	1930	65 76	1935	44 08

Table II shows that the difference between the driest and wettest months of record is considerable The precipitation for the wettest months has varied as much as 10 to 70 times the minimum with the greatest difference occurring in October (Fig 2) October, 1924, was the driest month on record with 0 11 inch and January, 1937, the wettest with 15 10 inches Each of the months has received less than an inch of precipitation at least once with the exception of June which has had a minimum of 1 05 inches The difference between the driest year, 1930, with 24 89 inches, and the wettest year, 1935, with 65 76 inches, is greater than 40 inches This shows a marked contrast within a period of five years

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[1] In this paper March, April, and May may be considered as being the spring months, June, July, and August, the summer months, September October and November, the autumn months, and December, January, and February, the winter months

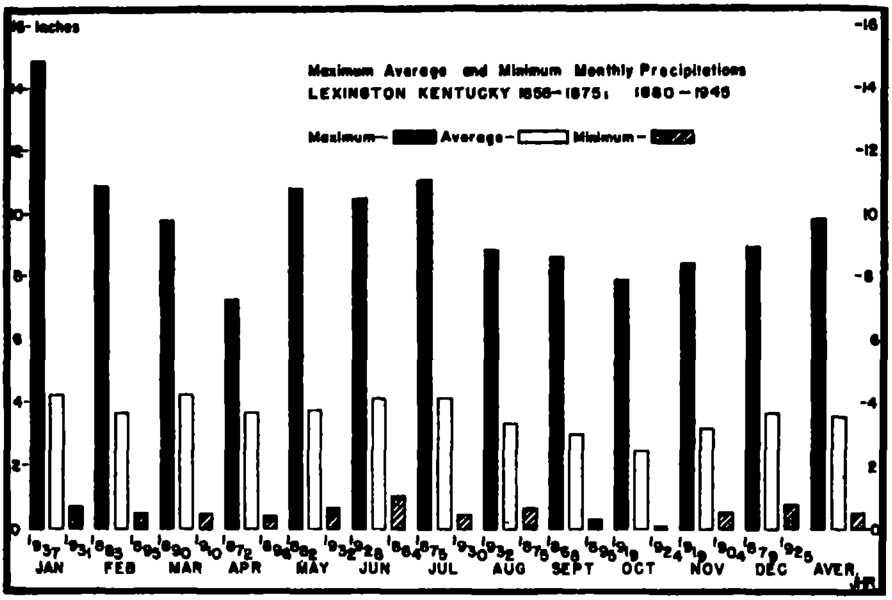

FIGURE 2

Table III shows the late summer and autumn months to be dry more often than the other months of the year It also shows the same period of the year to have had a lower percentage of months with 5 inches or more of precipitation

TABLE III

PERCENTAGES OF ALL MONTHS ON RECORD AT LEXINGTON

	Receiving 1 5 inches or less	Receiving 5 inches or more
January	4 8	28 6
February	7 1	17 9
March	6 0	38 1
April	8 3	22 6
May	8 3	25 0
June	3 6	26 2
July	8 3	31 0
August	14 3	20 2
September	17 9	13 1
October	28 6	10 7
November	13 1	17 9
December	3 6	26 2

During the record of 62 years 28% of the Octobers, for instance, had 1 5 inches of precipitation or less but only about 10% of them had 5 inches or more

The rainfall at Lexington is so well distributed that long periods of continuous wet or dry conditions do not exist without interruptions Occasionally there is too much rain, especially during the spring months, droughty conditions sometimes prevail in late summer or autumn, but timely rains often occur relieving the situation sufficiently to prevent serious disaster to the principal crops

The monthly and annual precipitation for an 84-year record, 1858–1945 with the exception of the years 1876–1879 inclusive, has been examined with a few very interesting observations During this period the annual precipitation exceeded the average of 44 08 inches 40 times, or 47 6% of the time, while it dropped under the average 44 times, or 52 4% of the time The graph (Fig 3) showing the departure from normal reveals this fact clearly The annual rainfall in 72% of the years has been over 40 inches, while 18% of the years it has been in excess of 50 inches, in 6% of the years over 60 inches was received There were only two years in which the total precipitation fell below 30 inches

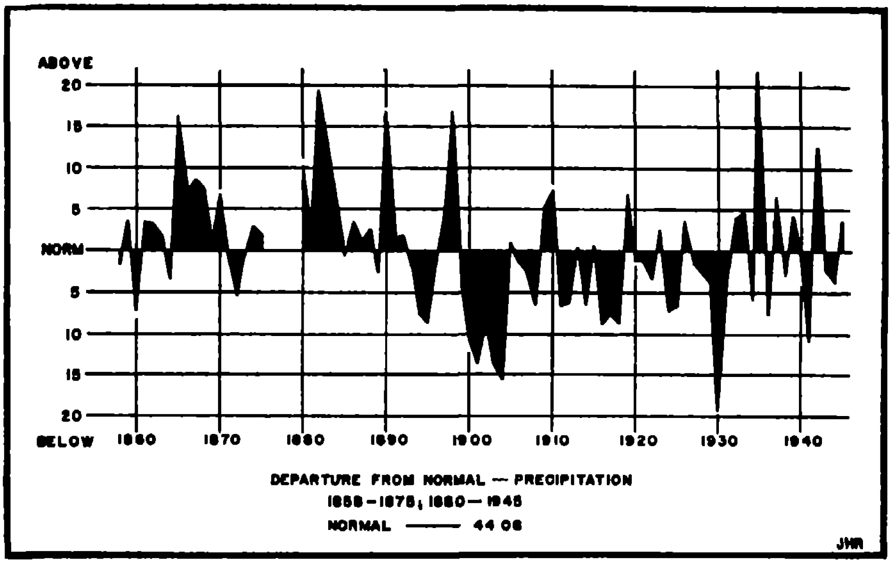

Figure 3

The monthly totals of precipitation of one inch or less (a very dry condition) have occurred the following number of times in the 84-year period January, 1, February, 4, March, 2, April, 3, May, 3, June 0, July, 5 August, 2, September, 9, October, 17, November, 4, December, 1 As previously shown, October is the driest month with an average of 2 45 inches, but this data reveals that a very dry October occurs 20% of the time or an average of once in five years The other months of the year, with the exception of September, are very dry only on rare occasions about 3% of the time, or an average of once in 34 years

Monthly totals for precipitation of more than twice the expected or average amount have occurred the following number of times at Lexington during the 84-year period January, 6, February, 9, March, 1, April, 0, May, 4, June, 2 July, 5, August, 7, September, 4, October, 9, November, 4, December, 3 April is the only month in which the precipitation did not double the average amount expected at any time January, February, August, and October more than doubled the expected on 31 occasions or for a total of 58% of the 54 times that it was doubled Monthly rainfall totals in excess of 10 inches have occurred 9 times, twice in each of January, May, June, and July and only once in February The greatest monthly total of 15 10 inches occurred in January, 1937

Table IV presents data on temperature and precipitation at Lexington over a 62-year period as indicated Although there are many periods in which rains of an intensity of 01 inch or more fell each day for five or six consecutive days, the longest period on official record is for 11 days This took place on two different occasions, May 3 to May 23, 1892, and again from August 12 to August 22, 1901 The Hillenmeyer records, somewhat contradictory to this, indicate that rain fell every day during the month of August, 1906, and during the following month of September the sun failed to break through the clouds and there was a trace or more of rain nearly every day Precipitation of 01 inch or more averages about 134 days each year

Floods are not unknown in Lexington and neighboring areas, and periods of heavy precipitation have been recorded on different occasions The most serious flood in Lexington's history took place on August 2, 1932, when more than eight inches of rain fell in 12 hours and Main Street became a turbulent river On June 28–29, 1928, 5 50 inches fell during the two consecutive days, and on September 3 1922 4 12 inches fell in a little over three hours or a total of 5 45 inches for the day A much earlier record, July 10–12, 1875, reveals a fall of 5 64 inches in an interval of 72 hours The Hillenmeyer records also show an uninterrupted rain of four days duration, September 27–30 1887, with a total fall of 3 65 inches Their records also give what is probably a record rainfall for a 30-minute period in Kentucky for on August 16, 1900, a fall of 2 24 inches was recorded in 30 minutes

TABLE IV

GREATEST NUMBER OF CONSECUTIVE DAYS

(1873–1876, 1888–1945)

Maximum	100° F or above	9 days	from July 7 to July 15, 1936
Maximum	90° F or above	21 days	from August 8 to August 28, 1936 also from July 23 to August 12 1941
Minimum	32° F or below	43 days,	from December 25, 1917 to February 5, 1918
Minimum	20° F or below	19 days	from January 3 to January 21 1893
Minimum	10° F or below	14 days	from January 20 to February 2 1936
Minimum	0° F or below	7 days,	from February 8 to February 14 1899
Precipitation	01 inch or more	11 days	May 3 to May 23 1892 also August 12 to August 22, 1901
Precipitation	less than 01 inch	26 days	October 5 to October 30 1924

Dry periods in which little or no rain is received over periods of 12 to 15 days occur rather regularly in late summer As a rule it is too late in the season to damage the crops, and in many cases may even be considered beneficial as it aids in the ripening processes The longest period of consecutive days in which less than 01 inch of precipitation fell occurred between October 5 and October 30, 1924, a period of 26 days During the year 1930, central Kentucky experienced its worst drought April and July were extremely dry, all spring and summer months being drier than usual and an annual precipitation of 24 89 inches, the lightest in the history of Lexington

Records of snowfall for Lexington have been tabulated for all months of the year excepting June, July, August, and September Traces have been observed as late as May 25 (1925) and as early as October 19 (1930) Snowfall in May and October, however, averages less than a day for each month with a maximum average of five days for January The average number of days with snowfall is 18 per year distributed as follows October, –, November, 1, December, 4, January, 5, February, 4, March, 3, April, 1, May, – The latest heavy snowfall ever recorded in Lexington fell on May 20, 1894, on which date a six-inch snowfall blanketed the city and surrounding country, a killing frost caused serious damage to garden and field crops

The longest period that snow, with a depth of 1 0 inch or more, has lain on the ground continuously is for 26 days, from January 12 to February 6, 1918 The maximum snowfall for any single storm occurred between January 13 and 15, 1917, when a total fall of 16 1 inches was recorded, both highway and railway traffic were blocked The thawing of this snow caused a washout of the gas line serving Lexington and as a result many homes were without heating facilities On January 26, 1943, 13 4 inches of snow fell during the day which is the heaviest recorded fall within such a period

Thunderstorms have been recorded for every month of the year, although the maximum intensity occurs in mid-summer In winter they are usually associated with the cold front of a cyclone while those of summer may be either of the same type or convectional Probably the most extensive mid-winter electrical storm took place on January 31, 1917, and was accompanied by much thunder The average monthly distribution of thunderstorms is as follows January, 1 February, 1, March, 2, April, 4, May, 6, June, 8, July 9, August 7, September, 4, October, 1 November, 1, December, 1 There is an average of 45 days a year with thunderstorms, the three summer months having 54% of the total

Although hail occurs infrequently at Lexington it does at times result in slight damage to local crops While no month of the year is immune, November is usually regarded as being less likely to have hail Some years may experience none whatsoever The largest hail ever seen in Fayette County fell on May 21 1917, when stones having a diameter of three and one-quarter inches were reported

The mean annual temperature at Lexington is 55 1° F (See Table I), and the mean monthly temperatures range from 33 7° F in January to 76 2° F in July, a total of 42 5°F The absolute range in temperature is from a low of −20°F to a high of 108°F, a total of 128°F Other temperature data may be observed from a study of Tables I and IV The range of temperature is great as might be expected from the continental location of Lexington The city also has a large amount of sunshine during the summer months which often results in high daily and monthly temperatures

Temperatures of 100° F or over are rather rare, some summers pass without experiencing it The highest temperature ever recorded was a reading of 108° F on July 10 and July 15, 1936 In this same year there were nine consecutive days with a temperature of 100° F or over, from July 7 to July 15 Temperatures of 100° F or over, however, have occurred as early as June 27 (1936), and as late as September 14 (1936 and 1939) Between the years 1888 and 1945 only 10 years had recorded temperatures of 100° F or over, an average of one year in every six Interesting to note, six of these 10 years with 100° F or over have occurred between 1934 and 1945 inclusive, during a 12-year period, while the other four were spread between the years 1888 and 1933 inclusive, over a 46-year period Lexington has had 35 days with a temperature of 100° F or over during this 58-year period Four of the 35 days occurred before 1934 and 31 that year and later

Further study reveals that all years have had temperatures of 90° F or over 90° F readings have been noted as early as April and as late as October, 80° F readings as early as March and as late as November, and 70° F readings at some time in every month of the year The greatest number of consecutive days with a temperature of 90° F or over has been 21 and was recorded on two different occasions, from August 8 to August 28, 1936, and again in 1941 from July 23 to August 12

Tables IV and V present minimum temperature data Subzero temperatures have not been experienced every year, but over the recorded period they have occurred 34 of the 62 years or approximately an average of one year in every two There have been only 128 days with a temperature of 0° F or lower, an average of two days every year Only 17 of the 128 days have experienced a temperature of −10° F or lower

The lowest temperature officially recorded in Lexington has been −20° F on February 13, 1899, and the next lowest −17° F on February 10 of the same year

Various unofficial readings from parts of central Kentucky report lower readings, one being −27° F for February 13 It was the coldest day of a week during which the temperature was below 0° F every day Official readings for the week were February 8 − 4° F , February 9, −15° F , February 10, −17° F , February 11, −4° F , February 12, −12° F , February 13, −20° F , February 14, −1° F The Kentucky River, solidly frozen, was passable for team and wagon The latest date with a temperature of below 0 ° F was March 4 (1873) with a reading of −1° F The earliest date was November 29 (1929) with a reading of 0° F , followed by −3° F the next day

It is interesting to note that 28 of the 34 years with 0° F or below occurred between the years 1888–1933, the same period that only four years had temperatures of 100° F or over In the interval, 1934–1945 inclusive, a temperature of 0° F or lower was recorded in six of the years As has been shown previously, this was the time when maximum readings of 100° F or over had been observed six years out of a total of ten during the 58-year period considered This would seem to indicate that there has been a slight shift from cooler to warmer conditions, however, the time period is too short for any definite conclusions

TABLE V

MINIMUM TEMPERATURE DATA

A—Number of Days Considered
B—Number of Days with indicated Minimum
C—Percentage of Total

	Jan	Feb	Mar	Apr	May	Sept	Oct	Nov	Dec
					32°F OR BELOW				
A	1922	1751	1922	1860	1922	1860	1922	1860	1922
B	1380	1207	857	224	3	1	107	675	1227
C	71 2	68 9	44 6	12 0	16	05	5 6	36 3	69 2
					20°F OR BELOW				
A	1922	1751	1922	1860				1860	1922
B	524	498	161	5				93	424
C	27 3	28 4	8 4	27				5 0	22 1
					10°F OR BELOW				
A	1922	1751	1922					1860	1922
B	225	176	23					8	120
C	11 7	10 1	1 2					43	6 2
					0°F OR BELOW				
A	1922	1751	1922					1860	1922
B	62	41	1					2	22
C	3 2	2 3	05					11	1 1

Table V, Minimum Temperature Data, enables one to compare the number of days of a given minimum temperature with the total number of possible days and to observe the percentage of the total For example, there were 1,922 days in the 62 Januarys considered Of these, 1,380 days had temperatures of 32°F or below at some time during the day, or a total of 71 2% of all days in January It will be seen that January is the coldest month with February and December slightly less so The latest date with a temperature of 32°F occurred on May 20, 1894, and the earliest date occurred on September 30, 1899

The average length of the frost-free season is 189 days, in four-fifths of the years it is 178 days The latest last killing frost in spring ever officially recorded was on May 20, 1894, and the earliest first killing frost in the autumn was on September 24, 1928 The last killing frost in spring occurs on the average on April 16 and in the autumn the average date of the first killing frost is October 22 In four-fifths of the years the last killing frost in spring comes about April 23 and the first killing frost in the autumn comes about October 18 The longest frost-free season has been 233 days and this has occurred on two different occasions during the recorded period In 1902 the frost-free period was from April 8 to November 27, and in 1922 from March 22 to November 10 The shortest frost-free period was 142 days in 1894, from May 20 to October 9.

The relative humidity at noon, local time, reaches an average of 74% in winter, 61% in spring, 58% in summer, and 62% in atumn The relative humidity at8 a m is somewhat higher with values of 82, 76, 78 and 79% respectively

The average number of days with dense fog is 11 per annum, the greatest number of these occurring in late atumn and the winter months The months of March, April, May, June, and July average less than a day each, August, September, and October have an average of one each, and November, December, January, and February have an average of two each

Over a period of 32 years, records show the percentage of possible sunshine to be greater in summer than in winter, 63% in July and August in contrast with only 35% in December Distribution of possible sunshine by seasons is as follows winter, 37%, spring, 52%, summer, 62%, autumn, 55% Summer not only has a greater percentage of possible sunshine but its hours of sunshine is about 60% more than in winter, 15 hours in June as contrasted with 9 hours in December The summer sunshine is also more intense than that of winter since the altitude of the sun in June is 75° 28′ while in December it is 28° 28′ The number of gram calories of heat per square centimeter of surface in June on a clear day is about 800 while that in December is only 270

The prevailing wind direction for Lexington is from the southwest throughout each month of the year over a 42-year period The average wind velocity ranges from 10 to 12 miles per hour, with values somewhat higher during the winter months and reaching a maximum average velocity of 13 2 miles per hour in March The wind probably reached one of its greatest measured velocities in 1918 when a maximum of 56 miles per hour was recorded Severe winds associated with tornadoes or tornado-like storms have been recorded on different occasions

This study does not fully present nor does it attempt to analyze all the phenomena of the weather and climate of Lexington Such a task is beyond the purpose of this paper The data selected and method of presentation may be improved upon, however, it is hoped that sufficient material has been assembled which will stimulate others to make similar studies, so that information relative to our weather and climate may be made available to all

MORPHOLOGY OF SPIRONEMA FRAGRANS, LINDL

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About eight years ago a friend gave me a small potted plant--a monocot with an attractive whorl of dark green leaves resembling *Dracaena* This grew into a high plant which began to lean and sprawl with its heavy crown of long leaves, next, it produced from the lower nodes long runner-like branches which quickly rooted in the soil in the green-house bench in which it's pot had been placed These off-sets I gave to friends as interesting house-plants As the sprawling parent plant became more awkward and ungainly with its numerous progeny around it forming a sort of jungle, I would discard the old plants and raise new ones as mere foliage plants, since it never bloomed Without any flowers I could not identify it I kept it as rampant but barren tropical stranger in our green-house collection

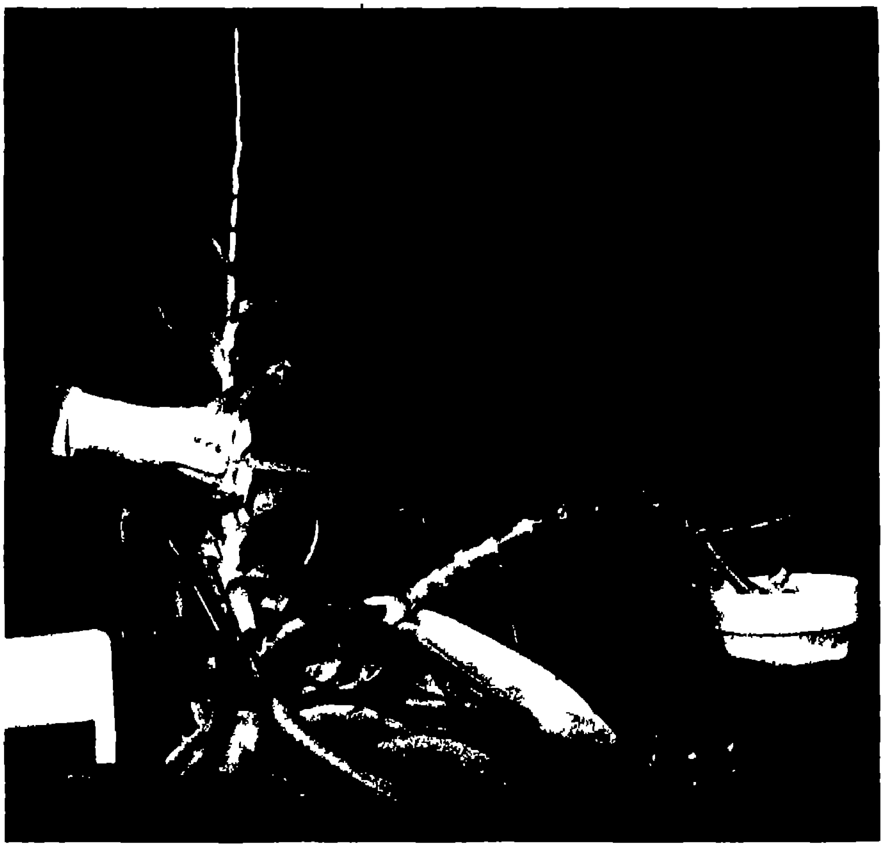

Fig 1 Three year old plant of *Spironema fragrans* in early stage of blooming

Finally in the spring of 1948 an old plant which I had kept as an ungainly relic became mature enough to bloom (Fig 1) In February it suddenly sent up a long naked wand-like stem which eventually developed lateral shoots These ultimately produced dense clusters of small deliciously fragrant white flowers (Fig 2) that filled the green-house with their perfume As I had no keys for tropical monocots which were not common in horticulture, I made sketches of the plant and its flowers and sent them to the Bronx Botanical Garden in New York The assistant curator, Mr Richard Howard, sent me its name—*Spironema fragrans*

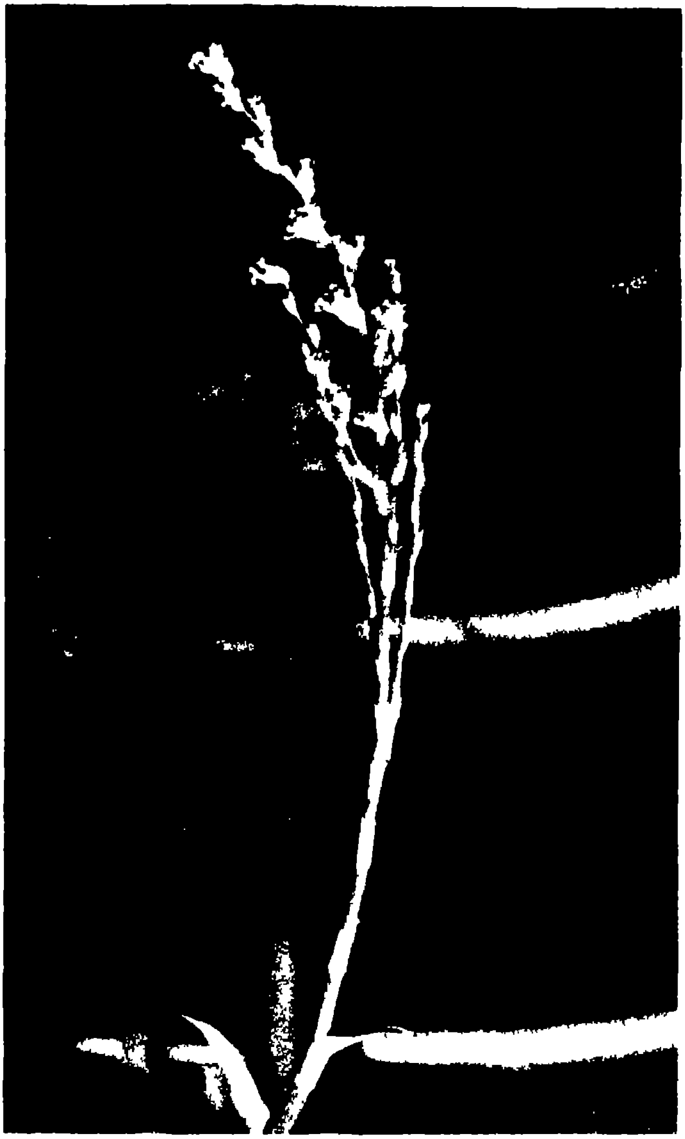

Fig 2 Inflorescence of *Spironema fragrans* at mature stage of bloom

Its nomenclature has gone through numerous vicissitudes Its earliest generic name was *Callisia* given by Linnaeus (1) in 1758 A specimen had apparently been sent to Linnaeus at Upsala, Sweden, by his former student, Pehr Löfling (2), whom it will be recalled was designated by Linnaeus as his best loved pupil Löfling had in later years become botanist to the Spanish Government in Madrid In this capacity he went on a botanical exploration trip to South America where he died

In his collections he sent back the plant which was named *Callisia* by his old teacher, Linnaeus

In 1763 the genus was renamed ***Hapolanthus*** by the Austrian Botanist, Nicolaus Jacquin (3) and in 1840 the English collector and student of American plants, John Lindley (4) christened it ***Spironema*** This was its valid name until 1903 when John K Small (5) of the Bronx Botanical Garden put it in the genus ***Tradescantella***

By this one can surmise that the plant is a member of the Commelinaceae in the Division Tradescantiae

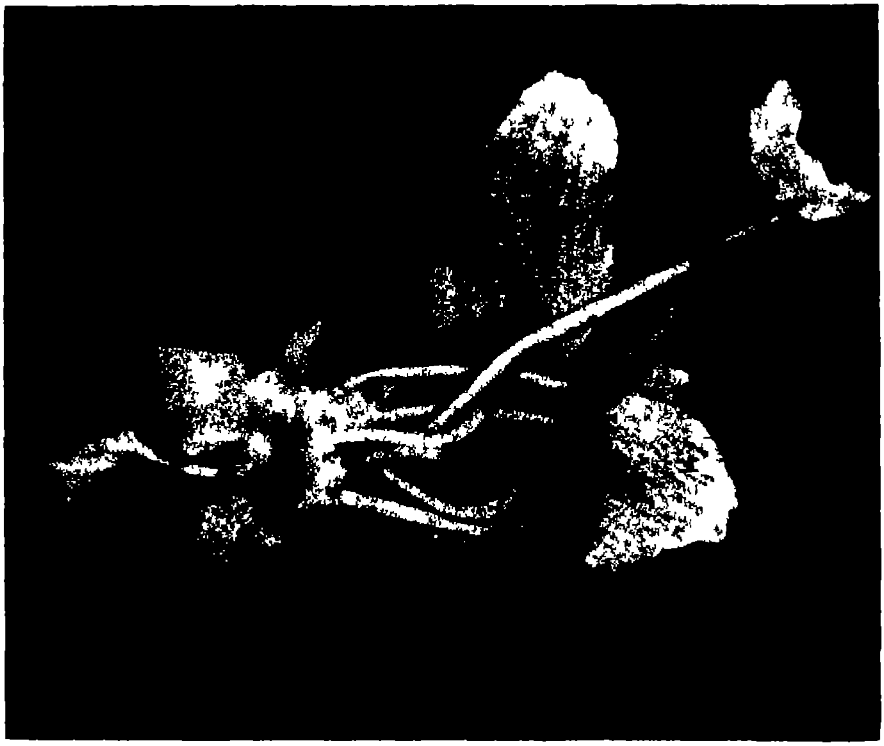

FIG 3 Magnified flower of *Spironema fragrans* X 20

In 1942, Robert E Woodson (6) of the Missouri Botanical Garden and who is at present writing a ***Flora of Panama*** (7) contributed an article to the Annals of the Missouri Botanical Garden entitled "A Commentary on the North American Genera of Commelinaceae" He described the plant under the name, ***Callisia fragrans*** (Lindl) Woodson ***Comb nov***

The plant's relationship to the genus ***Callisia*** is not very patent The older authors describe the genus as composed of "small prostrate running herbs with umbelliform, few flowered, inflorescences" Woodson says of ***C fragrans***, "aside from its gigantic size the relationship of this species to the small creeping plants of ***Callisia*** should be sufficiently clear"

But in spite of Woodson's statement it is not ***sufficiently clear*** that it should be included in ***Callisia*** as originally named by Linnaeus The more logical nomenclature would therefore be that favored by Engler and Prantl (8) and the Bronx Botanical Garden to retain Lindley's (1840) name of *Spironema* since in its habit it is strikingly different from the creeping species of *Callisia*

The flowers are held aloft in spike-like wands 3 to 4 feet tall (Fig 2) They are borne in compact globose clusters in the axils of tiny bracts and like most of its relatives in this family are ephemeral They open about 9.30 in the morning and all are shriveled and finished by 3.30 P M The blooming is also sporadic On March 20 of the year 1949, all of 5 large old plants burst into bloom simultaneously for one day Then no flowers opened until March 29, then a bloomless period until April 5, and again no flowers until April 10 These sudden and irregular spurts of bloom were not apparently due to the quantity of light nor the temperature, since the latter was uniform in the green-house and some of the blooming dates were clouded dark days and others were sunny

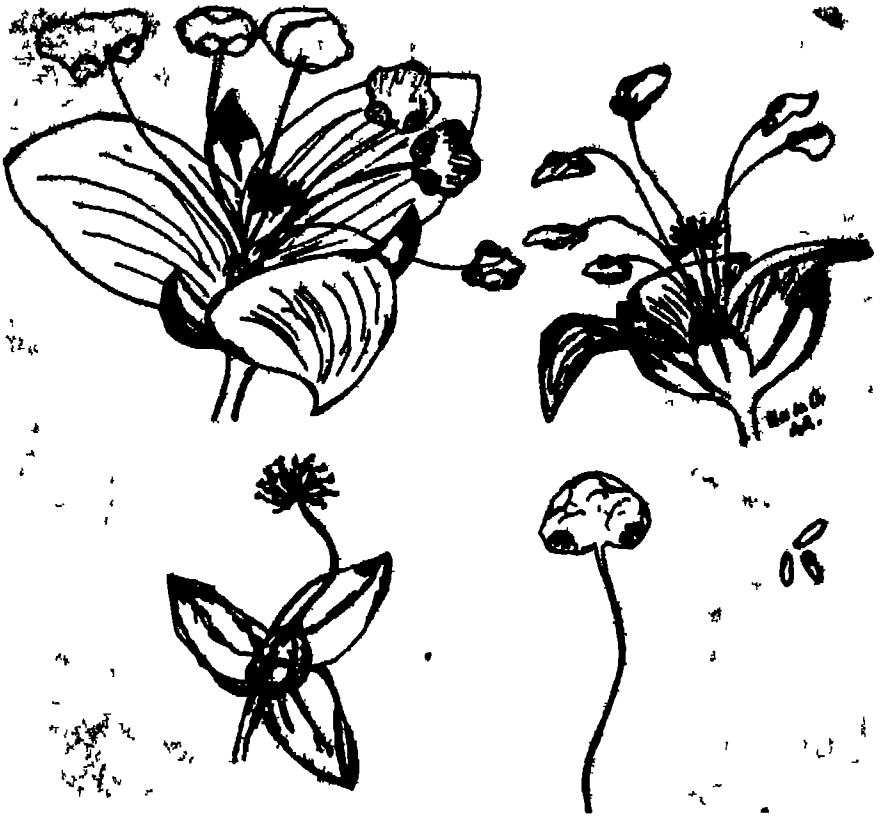

FIG 4 Floral parts of *Spironema fragrans* Drawings by H H M Bowman

The individual flowers (Fig 3) are most unusual especially with regard to the stamens The perianth is about one-fourth inch in diameter and 6-parted The three outer divisions are of a firmer texture with a slight greenish or purplish streak on the outer side The three inner divisions are broader and more petal-like and of a delicate transparent whiteness In the center is the pistil with a 3-celled superior ovary with 2 ovules in each cell, a filiform style is topped by a tufted plumose capitate stigma The stamens are 6 with very long spreading thread-like filaments which are about an inch in length, and elevated far beyond the cup of the perianth The connective of the stamen is exaggerated into an irregularly rounded-petal-like expanse of delicate white tissue with two small anther-sacs in the lower outer corners of the connective These are filled with rice-shaped pollen grains The delicate petal-like stamens with their long exserted filaments give a filmy or feathery character to the entire inflorescence (Fig 4) Engler and Prantl give the only illustration of the stamens that I have been able to find but their drawing is incorrect The connective is described as quadratic and the anther sacs are shown at the upper outer corners instead of the lower corners

How this tropical jungle plant from Central and South America came to Toledo I am unable to say It does not seem to be known to commercial firms and so far as I know is not grown as an ornamental plant by horticulturists It is my purpose to introduce to you therefore a plant little known in our latitude and one which is remarkable in its stamens and peculiar habits of growth Photographs of the plants in the University green-house and my original drawings illustrate the morphological features of *Spironema fragrans* Lindl

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SOME RECENT RECORDS OF THE FRESH-WATER JELLYFISH CRASPEDACUSTA SOWERBII FROM OHIO AND PENNSYLVANIA[1]

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During the past two decades much interest has been shown in the freshwater jellyfish *Craspedacusta sowerbii* Lancaster. A monograph on the species by Dejdar (1934) tabulated all of the world-wide records of occurrence known up to the date of his study. Bennett (1932) had earlier summarized the published accounts from North America, and Schmitt (1939) and Zeliff (1940) have added to the compilation of North American records. Pennsylvania records begin with the discovery in 1885 of the hydroid stage of this hydrozoan coelenterate by Potts who described it as *Microhydra ryderi*. In 1897 he reported the discovery of the medusa stage. This was followed by a series of published observations and studies of which the publication of 1906 is the most important. Payne (1924) has shown the relation of the hydroid to the medusa stage and has shown that the generic name of Craspedacusta takes precedence over that of Microhydra. However, he retained the trivial name *ryderi* for the American specimens. Boulenger and Flower (1929) and Dejdar (1934) demonstrated that *C. ryderi* is identical with *C. sowerbii* as described originally by Lancaster from specimens first discovered in the lily tank of Regent's Park in 1880 and which reappeared in 1928. American writers of recent years have used both names, one about as often as the other. It seems to the writers, however, that *C. sowerbii* should be regarded as the valid name. Additional records from Pennsylvania have been published by Brooks (1932), Quick and Matthews (1937), and Kuster (1938). Collecting records from Ohio have been reported by Baird (1932), Kraatz (1933), Linscheid (1935), Kostir (1941), and Dunham (1941–42).

Many persons have kindly assisted the writers with their studies and with the compilation of other new discoveries of *C. sowerbii* in the Ohio-Pennsylvania region. These who have contributed collecting data are mentioned in connection with their records, and to them our sincere thanks are given. Others to whom we are indebted for assistance are as follows: Dr. Fernandus Payne, Dr. J. Paul Visscher, Mrs. Martha Linscheid, Mr. Paul Shively, Mr. Blake B. Hanan, Mr. H. K. Datson, and the General Biological Supply House. In making state-wide contacts regarding the occurrence of fresh-water jellyfish in Ohio, the senior writer learned of the work of Dr. Surrarrer and Mr. Davis on this species. They were invited to join him in the production of this combined report, and acknowledgment is hereby given to their splendid cooperation.

NEW RECORDS FROM OHIO

Alfred G. Linscheid of the Shaker Heights Schools found an abundance of fresh-water medusae in Green Lake at Shaker Heights in the fall of 1934. Specimens had first been brought to him by a student of his school, H. V. Caldwell, Jr., but none has been found there since that time In October of that same year, abundant medusae were discovered in a goldfish pond at Nela Park in Cleveland Heights These were studied by Mrs Martha Linscheid who prepared a master's thesis on her studies for Western Reserve University (Linscheid, 1935) and presented a report of her work before the Ohio Academy of Science in the spring of 1935 Since that time Mr Henry Donahower, who made the original discovery, has seen small numbers of medusae during various years but unfortunately written records were not made In the last week of August, 1948, four specimens were collected We were notified of this recent collection through the courtesy of Mrs Harold R Nissley The pool, formerly a fire pool but now converted into an ornamental goldfish pond, is circular, has a diameter of 125 feet, a depth of 15 feet, and a capacity of 1 25 million gallons It was constructed in about 1912 In spite of periodic cleaning of the pond every three to five years, the jellyfish have reappeared over a span of 14 years Schmitt (1939) cited a number of similar cases where jellyfish have reappeared in the same artificial pool over a period of years

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[1] Presented before the zoology section of the Ohio Academy of Science April 22, 1949, at Denison University.

Dr William C Stehr of Ohio University has collected medusae from a reservoir three miles north of Athens during late May and June every year since 1934 Only female specimens have so far been observed Their abundance has fluctuated from year to year, but he found them particularly abundant in 1937 and 1942

In September of 1936 and 1937, Prof George R Easterling of Kent State University collected medusae from a sand-pit quarry pond two miles northwest of Chillicothe They were common in 1936, but much less numerous the second year The pond was circular in outline with a diameter of about 200 feet and a maximum depth of 10–12 feet

In August of 1940, fresh-water jellyfish were found in Round Lake, near Route 3 some 12 miles southwest of Wooster, in the corner junction of Holmes, Ashland, and Wayne Counties Specimens were brought to the College of Wooster Dr Ralph V Bangham of the college visited the lake within a short time after the discovery and collected a few specimens Round Lake is a small, pot-hole type of lake with a maximum depth of about 45–50 feet and with margins of peat bog It has a water surface of 35 acres On August 13, 1949, Mr Parke C Wachtel of Mansfield discovered a number of fresh-water jellyfish on the west side of the lake in a section of less than an acre in area and with a depth ranging from 15 to 25 feet He had fished this lake at least once each week and sometimes twice a week since April 1, but no jellyfish were observed until the 13th of August Apparently they appeared sometimes between April 6 and 13 On August 20 the medusae were found in great abundance, but one week later they were much reduced in number On August 30 he captured many specimens which were sent to Mr E L Wickliff, Chief of the Fish Management Section of the Ohio Division of Wildlife, who placed them on exhibition at the Ohio State Fair On September 3, Mr Wachtel found only a few specimens still remaining in the lake, and by September 10 they had disappeared

Blake B Hanan collected specimens of *C sowerbii* in the months of August, September, and October of 1941 from an old stone quarry lake (Smith quarry) near Berea (see figure 1) which had been abandoned for some 25 years Some of the specimens were forwarded to Kent State University He found the medusae in great numbers especially along the edges of the water where 2–3 specimens were found per square yard from the surface to a depth of about four feet The body of water filling the quarry measured approximately 150 x 600 feet with an estimated depth of 60–70 feet That same year Dr Thomas C Surrarrer collected specimens in October from the same quarry The eight specimens which have been saved are all males The gonads of 50 specimens, probably all of them males, placed in aquaria on October 21, ruptured on October 30 Other quarries in the vicinity which were examined did not yield any jellyfish that year In September of 1942, *C sowerbii* was again collected from Smith quarry but it was less abundant than in the preceding year In October of 1943, only a few specimens could be found there This quarry was then drained and reworked, but soon abandoned once more After its being refilled with water, medusae were not found again after a careful search in 1946, 1947, and 1948 In the fall of the years 1943–1947 inclusive, a number of jellyfish were found each year in a nearby quarry, West View quarry, but none was found there in 1948 In 1947, however, they were also present in a second quarry at West View This one had been drained in 1944 and reworked for a time Jellyfish were not found there in earlier years or in 1948 All three of these quarries at Berea were filled with deep-blue, clear water

Mr T G Gallagher, Chief of the Pollution Control Section of the Ohio Division of Conservation, discovered an abundant population of fresh-water medusae in Lake Alma in July of 1945 While fishing in the lake he observed a slowly moving stream of the jellyfish some 20 feet wide and about 200 yards long which moved in a counterclockwise direction around an island in the lake One dip of a quart jar captured 17 individuals They ranged in size from one-quarter of an inch to one inch in diameter, the average being about three-fourths of an inch At the time of collecting, the surface water was 79°F with a drop to 75°F at a depth of 12 feet The pH reading one foot below the surface was 6 4 The captured medusae were placed in an aquarium with two guppies, both of which were dead by the next morning One of the fish had a large jellyfish clamped to it by its tentacles Lake Alma is in Clinton Township of Vinton County, about two miles southeast of Hamden It is an impounded lake built in 1900 An earthen dam has created a somewhat circular lake with an island near the center There is a surface of 72 5 acres of water, an average depth of 9 7 feet, and maximum depth of a little over 16 feet Roach and Pelton (1947) have published a limnological and fishery management survey report on this lake

FIG 1 Smith quarry near Berea Typical quarry habitat of *Craspedacusta sowerbii* Photo by Blake B Hanan

In September, 1947, a student of Kent State University brought to the biology laboratories a number of living medusae which he had collected from Stewart Lake, near Twin Lakes, in which they were very common These were kept alive for several days as a demonstration in the laboratories At the same time the senior writer heard of a report of jellyfish from Crystal Lake near Ravenna, only nine miles from Stewart Lake Several specimens had been collected on August 31 by two students, Helen Stuart and George Price On September 24, the lake was visited, at which time *C sowerbii* was found to be still abundant They were widely distributed over the lake, but were particularly common on the leeward side Three days later Walter Evans, a school boy living at the lake, collected a few specimens, but no more were seen after that date All of the 42 specimens preserved from this lake were females The size ranged from 6–12 mm in diameter and the tentacles were arranged in six different size groups Cladocerans and copepods were found entangled in the tentacles Crystal Lake is a natural glacial lake of approximately 25 acres and with a greatest depth of about 30 feet It is used as a water supply for the City of Ravenna and for sport fishing Fishermen reported difficulty in getting fish to bite during the time when the jellyfish were at their peak of abundance Possibly the fish were feeding on the medusae Two fishermen, Howard Kastor and Gordon Klohn, claim to have seen a few jellyfish in this lake each year between 1937 and 1947, and a considerable number in about 1942 How dependable those observations were cannot be stated since specimens were not collected In August, 1948 a total of four specimens was collected by Walter Evans which were the only ones found that year at Crystal Lake

Also in the summer and fall of 1947, abundant specimens were collected from Lake Milton, 14 miles east of Crystal Lake Charles W Davis, assisted by Dr Claire L Worley of Youngstown College, collected medusae from a small bay of Lake Milton In 17 years of living on the shore of this bay, the Davis family had never previously observed jellyfish in the lake Many specimens were collected during the first two weeks of May From the middle of June to the middle of July the jellyfish were most abundant From the middle of July to August 10 only a few were seen, but after this date they became abundant again until the first week of September when they decreased in number Few were obtained in September and none observed in October All of the specimens observed that year were found restricted to the small bay directly in front of the Davis cottage, and for the most part centered around a snag of tree branches some 30 feet in diameter which had been submerged at the spot for attracting game fish Jellyfish were observed floating up out of this snag By striking the submerged branches with a boat oar, many individuals were liberated which came to the surface Specimens which were preserved, about 25 in number, were all females (see figure 2) Lake Milton was impounded in 1916 in the Mahoning River Valley to supply water for the steel plants of Youngstown It has an area at present of 1,700 acres, with a maximum depth of about 46 feet The average depth is 12 feet At no other place in the lake, however, have medusae yet been observed The size of preserved specimens are the same as those collected from Crystal Lake, 6–12 mm , but some were observed in the water by Mr Davis that were about 30 mm in diameter In the summer of 1948 the medusae did not appear until the first week of September Mr Glen Davis, owner of the Davis cottage, collected about 10 specimens at that time from the same location They were fairly numerous for two weeks, but not nearly so abundant as they had been the preceding year Two fishermen reported observing them in middle September, having found them over the same snag The senior writer, accompanied by Mr Glen Davis, was unable to find any on September 26

Prof William Adams, Jr and Prof W Hughes Barnes of Muskingum College collected abundant specimens of *C sowerbii* from a limestone quarry near Zanesville between July and October of 1947 and 1948 They plan to publish the detailed results of their observations at a later date

NEW RECORDS FROM PENNSYLVANIA

Prof Kimber C Kuster of the State Teachers College, Bloomsburg, Pennsylvania, published a note (1938) on the collection of medusae from an abandoned limestone quarry near the village of Almedia, Columbia County, from August to October of 1937 He has written to us that since that time medusae have been found every summer in the same quarry until the season of 1947 when they were neither observed by him nor reported to him by bathers During the ten-year interval when medusae were observed, they varied in abundance from one year to another, being very common some years and much less common other years

Mr David Shortess collected a great abundance of medusae for the General Biological Supply House from Fox Run, a slow-moving stream, some five miles northwest of York in the late summer of 1946 The stream is 25 feet wide and not over three feet deep where the collection was made Shortly after his specimens were collected a rain storm swelled the stream, sweeping away the population, and medusae have not been found there since He observed two color groups, "clear white" and "greenish "

On September 15 and 16, 1947, Ladd Heldenbrand, a student at Kent State University at the time, discovered fresh-water jellyfish in abundance at the northern end of Lake Wallenpaupack Attempts to capture specimens with his hands failed Unfortunately collecting equipment was not available However since he had previously studied preserved specimens in the zoological laboratories and he was able to make close observation of large numbers in the lake, there can be no question as to the correctness of his identification This lake was impounded in the Wallenpaupack River in 1923 for hydroelectric power by the Pennsylvania Power and Light Company of Scranton The lake is some 30 miles east of Scranton It is 12 miles long with an average width of two miles Total area is 216,000 acres, and greatest depth is 90 feet The medusae were found over a stretch of about three miles In the summer of 1948 Mr Heldenbrand returned with collecting equipment, but specimens were neither found nor reported by anyone on the lake On September 5, 1949, however, he succeeded in collecting specimens of *C sowerbii* which were found in abundance distributed throughout an area of

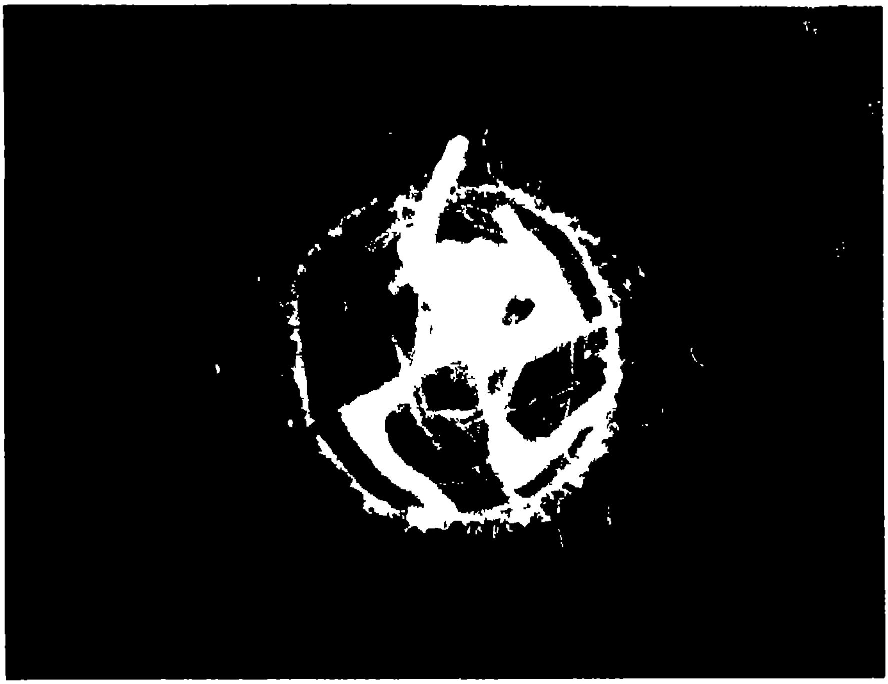

FIG 2 *Craspedacusta sowerbii* from Lake Milton 1947
Photo by H K Ditson

about one square mile Thirty-seven specimens sent to the senior writer for study ranged in size from 7–15 mm , the great majority being 12–15 mm All of these specimens were females, and all of the loose gonads from broken medusae were ovaries At the time of collecting, the surface water was very still and its temperature was 68° F The following day no specimens could be found Deevey and Brooks (1943) reported *C sowerbii* from a lake in Connecticut with an area of 271 acres and a maximum depth of 65 feet They claimed that it was the first record of fresh-water medusae from an open lake The above discovery of medusae in Lake Wallenpaupack enlarges the known lake-size habitat of this organism many times

NOTES ON HABITAT, SEASONAL OCCURRENCE AND GEOGRAPHICAL DISTRIBUTION

Fresh-water medusae have been most often found in quarry and fish ponds, concrete pools and tanks, gravel pits, and small shallow lakes This paper reports specimens from two large impounded lakes, Lake Milton and Lake Wallenpaupack both of which are much larger than any previously reported lake habitat One stream population, that of Fox Run, is added to the few records of such a habitat known from North America Previously, Takony Creek and the Schuykill River in Pennsylvania, the Vermillion River in Ohio, Benson Creek and the Kentucky River in Kentucky, and Williamette River in Oregon have been reported The statement of Dejdar (1934) that *C sowerbii* is found ' in natural lakes that are apparently always connected with flowing water" is certainly not the case in many of the American records made from such habitats as artificial goldfish ponds, quarry ponds, concrete tanks, etc

Many zoologists believe that the hydroid stage is introduced into bodies of water with transplanted water plants or fish, and that it reproduces by asexual budding only Thus is explained the collecting of males only by Viosca and Burkenroad (1936), Van Auken (Loudonville specimens) (1940), Deevey and Brooks (1943) Fincher and Buchanan (1944), and from the Berea quarries described in this paper, and of females only by Payne (1924), Baird (1932), Woodhead (1933), Milne (1938), Powers (1938), Van Auken (Garnet Lake specimens) (1940), and from a reservoir near Athens, Crystal Lake, and Lake Milton as mentioned in this paper Only Payne (1926) has reported collecting both sexes together He concluded that in budding off medusae the hydroids are apparently male producing or female producing exclusively The matter was summarized in an unpublished report by Kostir (1941)

Schmitt (1939) repeated his prediction made 12 years earlier that more and more specimens of the sporadic and relatively rare fresh-water medusae would be found and reported as more attention over a wider area was turned to the problem In addition to the increase in the number and distribution of observers, another factor which seems to bring records of occurrence to light is that certain years are apparently favorable ones for the production of this organism in great quantity The years of 1932, 1933, 1934, 1936, 1937, and 1947 were times when most of the recent North American records have been discovered and years when jellyfish were found in great abundance

Most of the collecting in this country has been done from July to October, although records are known as early as May and as late as November September is the month of most frequent discovery and greatest abundance

Fresh-water medusae have been reported from 25 states (Conn , N Y , N J , Penn , Md , Va , W Va , Ohio, Mich , Ind , Ill , Ky , Tenn , Ga , Ala , Miss , La , Ark , Mo , Iowa, Texas, Okla , Kan , Ore , and Wash), Washington D C , Quebec, and the Panama Canal Zone All of the state records except Oregon and Washington (aquarium record only from Washington) are in the eastern half of the United States

SUMMARY

1 The fresh-water medusa *Craspedacusta sowerbii* is reported from 12 new localities in Ohio and Pennsylvania and from two previously known localities in which it has reappeared

2 Two lake habitats are recorded, Lake Milton in Ohio and Lake Wallenpaupack in Pennsylvania, which are the largest yet known to be inhabited by jellyfish

3 Medusae are usually found from July to October in quarry and fish ponds, reservoirs, and small lakes

4 A new stream record (Fox Run in Pennsylvania) is reported for North America

5 All state and similar locality records known from North America are listed

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A MANOMETRIC PIPETTING DEVICE

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Franz Theodore Stone Laboratory, The Ohio State University

The pipetting device herein described has enabled me to make 100 ml dilutions faster and with much less fatigue than the pipetting by mouth method The device can be used in a variety of situations where definite volumes are to be dispensed It can also be used where a safety pipette is desirable especially with radioactive materials Cleaning time is less than for other types of automatic and mechanical dispensing devices since the only part that requires cleaning is the pipette The principle involved is simple so that others may have developed essentially similar devices but so far as I am aware they have not been described

The device is diagrammed in Fig 1 The pipette may be of any size and type that is emptied completely This is connected by means of a rubber tube to a gas collecting tube of 250 ml capacity The gas collecting tube is in turn connected by means of a second rubber tube to a leveling bulb of 250 ml capacity These parts are supported on a stand with a heavy base and a rod 36 in long and 0 5 in in diameter The pipette is held by a burette clamp The gas collecting tube is held by a large burette clamp A fixed leveling bulb support is mounted above the gas collecting tube at a level to hold the upper end of the tubulation of the leveling bulb 2–3 cm below the upper end of the expanded portion of the gas collecting tube An adjustable leveling bulb support is mounted below the gas collecting tube After the apparatus is assembled it is filled with water to the level shown in Fig 1

The pipetting procedure is as follows Place the leveling bulb in the fixed support Adjust the lower leveling bulb support so that the distance between it and the fixed support is a centimeter or two greater than the distance between the tip of the pipette and the graduation mark If the density of the liquid to be dispensed is different from that of water the distance should be proportional to the specific gravity of the liquid To fill the pipette a vessel containing the liquid to be dispensed is raised to immerse the tip of the pipette and the leveling bulb lowered to the adjustable support If the adjustable leveling bulb support is adjusted precisely the liquid level in the pipette will drop to the graduation mark on withdrawing the vessel If the liquid level in the pipette falls below the graduation mark the vessel should again be raised to the pipette and the adjustable support lowered until the liquid level in the pipette falls to the graduation mark on withdrawing the vessel If the liquid level falls above the graduation mark the adjustable support should be raised until the liquid level falls to the graduation mark The pipette is emptied by raising the leveling bulb to the fixed support Once adjusted to a pipette only minor adjustments need be made from time to time

Any type and size of pipette can be used with this device Mohr type pipettes have been used by adding a second adjustable leveling bulb support below the fixed support and adjusted to stop the emptying of the pipette at a given graduation mark The pipette itself may be mounted on a separate support which may be at a distance from the remainder of the apparatus In this way the device can be used advantageously in pipetting radioactive materials

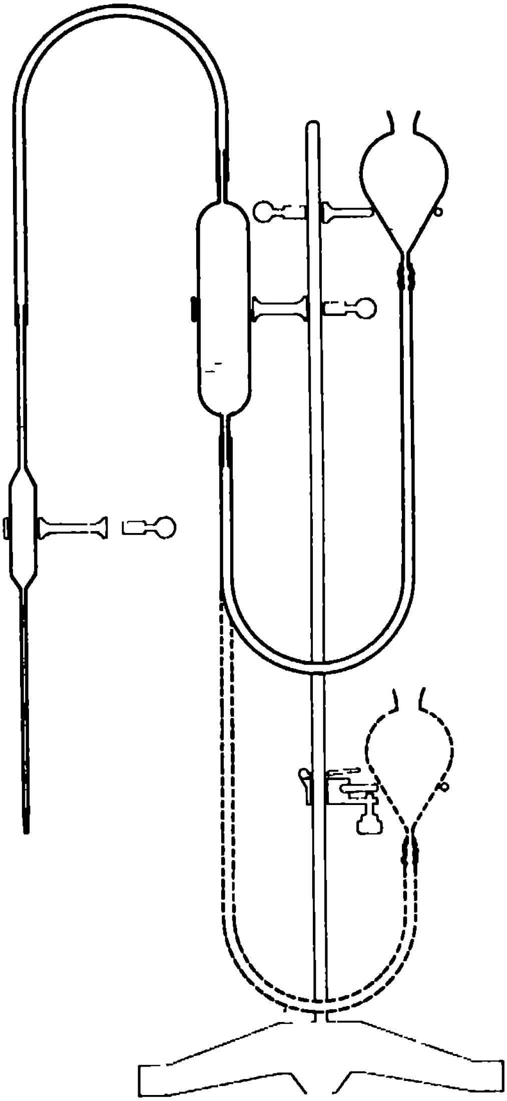

Fig 1 A manometric pipetting device

NEW SPECIES OF NEW WORLD BACCHA

F M HULL,
University of Mississippi

Several new species of American flies of the Syrphid genus *Baccha* are here described The types are in the author's collection

Baccha zabulon n sp

Related to *vespuccia* Hull and *brunnipennis* Hull The hind femora and tibiae are quite pale yellow, not brown, the femora are blackish annulate Wings slightly paler in color, the V shaped yellow spots of the fourth segment are more broadly joined to the minute, yellow, basal triangles Length 9 mm

Female.—*Head* face and cheeks pale yellow, the front yellow, except for a medial brownish stripe running three-fourths of the length of the front The preantennal callus is brownish above with a small black spot anteriorly The first two segments of the antennae are yellow, the third is missing The vertex is black with golden brown pollen the black pile lies in a single row Pile of front black, of face yellow Occiput black with yellowish grey pollen and golden, non flattened pile, the pile of the upper third black *Thorax* mesonotum black, quite widely pale yellow along the sides including the humeri and post calli and the whole of the scutellum The scutellum is barely darker in oblique view but appears clearly yellow from above. The middle of the mesonotum is obscurely vittate with yellowish or reddish brown pollen There is no anterior collar and the pile is sparse and yellowish The pile of the scutellum consists of a very few long fine black hairs There appears to be no ventral fringe The pleura are yellow with a diagonal brownish black band posteriorly occupying the sternopleura, metapleura and hypopleura Squamae and fringe dark sepia Halteres light reddish brown *Legs* all coxae and trochanters yellow The anterior and middle legs and the whole of the hind legs except a distinct wide, brown, subapical, femoral annulus, are yellow in color *Wings* uniformly tinged with light brown, the pterostigma scarcely darker The third vein is gently arched, the costa drawn backward the preanal spuria distinct, the alulae narrow, not wider than the width of the basal section of the costal cell *Abdomen* spatulate but little narrowed basally The first segment is yellow with the posterior margin brown except upon the sides The second segment is one and two-thirds as long as wide, just before the middle there is a broad, gently arched yellow band bordered anteriorly and posteriorly with opaque reddish sepia The third segment is similar, a little shorter, a little wider posteriorly and the yellow band is now narrowly divided in the middle, wider in the middle and located in the middle of the segment Thus this segment has a pair of closely approximate, yellowish triangles which reach narrowly to the lateral margin and which are bordered by opaque sepia The fourth segment has on either side a deep-cleft, inverted, V shaped spot which is rather broadly connected to the minute, submedial, basal yellow triangles The outer limb of the "V" is broadly rounded and at least twice as wide outwardly as basally, the medial limbs of either side slightly converge posteriorly, are broadly rounded medially and their tips diverge and do not reach the posterior margin These yellow figures are narrowly margined anteriorly with opaque brown and the clefts and medial space is filled with opaque brown Fifth segment with a pair of submedial vittae similar to those of the fourth segment and with a pair of shorter, diagonal, sublateral yellow vittae which narrowly connect with a submedial pair at the base The submedial vittae reach the posterior margin Sixth segment yellow with two slender brownish black vittae

Holotype female, Chanchamayo, Peru, August 20, 1948, J Schunke.

Baccha halcyone n sp

Related to *verona* Curran The U-shaped yellow spots of abdominal segments three and four are not so deeply cleft, the fifth segment is quadrivittate. Length 6 5 mm

Male —*Head* face, cheeks and front entirely pale yellow, the latter with a very minute, scarcely noticeable pale brown spot on the pre-antennal callus instead of the usual distinct black spot The pile of the front is blackish, of the face yellow The antennae are orange, the arista blackish The vertex is blackish, the occiput black, somewhat crumpled and greasy *Thorax* mesonotum black with brassy reflections, the pollen obscured by poor preservation, the sides of the mesonotum including the humeri postcalli and the scutellum are pale yellow There is no anterior collar of pile The mesonotal hair is fine and dark in color Similarly the scutellar pile is sparse, fine, long and black Ventral scutellar fringe absent The pleura are pale yellow, the lower sternopleura, the metapleura and hypopleura sepia brown Squamae brown, the halteres sepia with the stalk pale *Legs* anterior and middle legs entirely pale yellow The posterior fringe of the middle femora yellow the hind femora with dark brown, wide, subapical annulus and less distinctly brown at the base Hind tibiae biannulate, being light brown apically and just before the middle Hind tarsi entirely yellow *Wings* not quite hyaline, the pterostigma pale brown Alula quite absent The preanal spuria is almost completely absent The third vein is gently arched, the costa drawn considerably backwards *Abdomen* petiolate, the first segment yellow, shining brown posteriorly except upon the sides The second segment is subcylindrical, three to three and a half times as long as its middle width, it is sepia brown in color except that the sides upon the basal half are diffusely shining yellowish but the yellow color is scarcely visible from above Just past the middle there are a pair of narrowly separated, sharp, distinct bright yellow spots bordered anteriorly and posteriorly with opaque sepia Third segment nearly twice as wide posteriorly as basally, within the middle there is a pair of narrowly separated clear yellow triangles which are indented in the middle of their posterior margins Thus these spots resemble inverted V shaped marks in which the clefts have been largely filled by yellow These spots are broadly banded by opaque sepia which anteriorly extends nearly to the base of the segment The fourth segment has similar larger, more elongate, more deeply cleft and a little more widely separated clear yellow spots which are narrowly extended to reach the base of the segment The medial area, the cleft and a very narrow margin antero laterally are opaque sepia The fifth segment has four yellow wedge-shaped vittae all about equally separated from one another The medial pair are slightly longer but do not reach the posterior margin They are separated by opaque sepia brown

Holotype male Chanchamayo, Peru, August 16, 1948 1100 meters, J Schunke

Baccha zerene n sp

Related to *mexicana* Curran There is a pair of dull grey vittate marks enclosed in the opaque black triangle of the third and fourth segment Females with these opaque subtriangular bands wholly black Length 12 5–16 mm

Male —*Head* face black, diffusely yellowish white along the sides The cheeks are black, the front shining black with an opaque black triangle above The preantennal callus is large yellowish brown laterally, black in the middle and black posteriorly The pile of the face and front is abundant, long and black The facial pollen is distinctly white to silvery, extending narrowly up along the sides of the front as far as the middle where it ends and re-appears near the upper third of the front only to disappear at the base of the opaque black triangle The antennae are quite black, only the base of the third segment is narrowly reddish below The arista is black a little reddish at the extreme base The vertex is black shining behind, but more nearly opaque between the ocelli, the black pile appears to be in a single row The occiput is black with nearly white pollen with a row of long, scarcely flattened, white hairs in the middle The upper occipital pile and the hairs next to the eye margin in the middle of the occiput are black *Thorax* black with very faint, submedial, reddish sepia, pollinose vittae which do not extend beyond the suture There is no distinct area of lighter pollen in front of the scutellum The scutellum is nearly black, but actually is perhaps of a very dark sepia color The mesonotal pile is abundant, short and black, the scutellar pile similar The ventral fringe consists of eight or nine pairs of yellow hairs, some of them quite long Mesonotum with a well developed, pale yellow anterior collar of pile The squamae and fringe are dark sepia, the halteres reddish sepia The pleura are shining black, the posterior margin of the mesopleura obscurely reddish brown

Pleural pile yellow with a fringe of black hairs along the upper posterior margin of the mesopleura Pollen whitish *Legs* anterior and middle femora very dark reddish sepia, the middle pair almost black posteriorly, their tibiae nearly black, the tarsi also nearly black The hind femora and tibiae are entirely black with dense, short black pile throughout The hind basitarsi are blackish on the basal two-thirds, the remainder of these tarsi nearly white with white pile *Wings* deeply tinged with sepia on the entire base to just beyond the anterior cross vein with the exception of the anal cell, which is considerably paler at least on the marginal half The posterior half and base of the preanal cell is also somewhat paler Alulae wide, dark brown basally, diffusely merging into the subhyaline border The dark sepia area of the base of the wing is nowhere sharply marked and grades diffusely off into the pale grey, nearly hyaline portion of the remainder of the wing The marginal cell and whole of the submarginal cell are distinctly brown, but not quite so dark as the basal part of the wing The preanal spuria is distinct The third longitudinal vein is slightly curved backward before the end of the subapical cross vein *Abdomen* quite petiolate The first segment is shining black, the second segment is nearly six times as long as its least width, very little more narrow in the middle than apically and its base and apex of nearly the same width This segment is light reddish sepia with beginning a short distance from the posterior margin, a large, extensive, opaque nearly black triangle which is quite long and acute and which reaches to within a short distance of the base The third segment is similarly colored basolaterally, the posterior margin shining blackish, the greater part of this segment occupied by a very large, opaque black triangle which encloses a pair of obscure reddish, vittate streaks The fourth segment also has a very large but shorter and broader opaque black triangle which like that of the third reaches the base of the segment and encloses a pair of similar though lead grey vittate spots The basal corners of this segment are more narrowly light reddish brown The fifth segment is shining black with three, short oval, opaque black basal spots The pile of the abdomen is everywhere black except posteriorly upon the first segment where it is whitish First segment pile long

Female —Face and head similar to the male, the front black, the white linear pollen along the eye margins uninterrupted The squamae are very pale yellow but the fringe reddish sepia The legs are similar to the male, the dorsal pile of the middle tarsi whitish, the anterior tarsal pile black dorsally The abdomen has the second segment only about two and a half times as long as its least width it is very little narrowed in the middle The third segment is as long as its posterior width and the posterior width not quite twice as wide as the basal width The fourth segment is a little wider than long, the fifth segment nearly twice as wide as its length Sixth segment almost as wide basally as the length of the segment and considerably narrowed posteriorly with a medial ridge The seventh segment is laterally flattened The second and third segments each have a large central, opaque black triangle. The fourth segment has a large, broad, gently arched, opaque black band reaching nearly to the base of the segment, it is somewhat arched and occupies nearly the whole of the segment The fifth segment is indistinctly opaque in the middle, the crumpled condition makes it difficult to discover the pattern The sixth segment is entirely shining black Pile of abdomen black except for a few white hairs along the sides of the second segment in the middle and anteriorly and posteriorly along the sides of the first segment

Holotype male, Chanchamayo, Peru, August 3, 1948 allotype, a female, July 17, 1948, J Schunke

A TABULATION OF OHIO BOBWHITE QUAIL FOODS

VINCENT SCHULTZ[1]

The Ohio State University, Columbus Ohio

Although the bobwhite quail, *Colinus v virginianus*, has been on the protected list in Ohio since 1912, the time may come when vigorous legislative pressure will change its status from that of a song bird to a game species Knowledge of the food requirements of a game species is one of the first essentials to the establishment of sound management practices The almost complete lack of data on the food habits of the bobwhite quail in Ohio has led the writer to present a detailed report, for the records, of the analysis of 70 quail crops These crops were collected in various Ohio counties while conducting a vitamin A deficiency study on the bobwhite quail during the winter of 1946–47

Of the two food habit studies known to have been made in Ohio neither one is of any great value due to limited availability and incompleteness The results of Judd's study in 1890 is limited to 8 specimen cards on file at the Patuxent Research Refuge, Laurel, Maryland Hick's report (Bullentin Number 105 of The Ohio Division of Conservation and Natural Resources) on the analysis of 68 quail stomachs is of limited value as it is not readily available and the results obtained from birds from various physiographic areas of the state have been combined It is the writer's opinion that the results should be tabulated on a physiographic bais rather than by using a method of combining the results and considering the final results as indicative of the feeding habits of the quail in Ohio No method of compiling the results of stomach or crop analysis is entirely free from the danger of misrepresentation of a species' actual food habits An attempt is made in Tables 1 and 2 to eliminate or reduce to a practical minimum this tendency of misrepresentation These tables contain the results of the analysis of 70 quail crops Birds that are trapped by baiting generally have little or no natural food present in their crops, therefore, data from such birds presented on a total volume basis are not comparable with similar data obtained from birds collected by shooting As data obtained from quail that were shot or trapped was not considered to be comparable, presentation of the findings is in two separate tables Table 1 contains data obtained from 46 quail collected by shooting from various counties, as follows Athens (Nov —1 bird), Cuyahoga (Aug —1 bird, Jan —1 bird, Mar —2 birds), Delaware (Nov —2 birds), Medina (Jan —1 bird), Meigs (Dec —2 birds), Montgomery (Jan —1 bird), Vinton (Nov —6 birds, Dec —17 birds, Jan – 6 birds, Feb —8 birds), and Williams (Nov —1 bird) Table 2 contains data obtained from 24 birds trapped by baiting, as follows Delaware (Dec —7 birds), Franklin (Oct —5 birds, Nov —2 birds, Dec —1 bird, Feb —4 birds) and Medina (Feb —5 birds) Commercial scratch feed and cracked corn were used as bait and as their presence in the crops resulted from unnatural conditions they were not tabulated in Table 2[2]

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[1] The analyses were conducted while on a research fellowship granted by The Ohio Co-operative Wildlife Research Unit The Ohio State University, The Ohio Division of Conservation and Natural Resources The Fish and Wildlife Service and The Wildlife Management Institute co-operating Personal acknowledgments are made to A C Martin, R T Mitchell, K A Mitchell, R Will and D L Leedy

TABLE I

CONTENTS OF QUAIL CROPS FROM SHOT SPECIMENS

I PLANT MATERIAL	
Acalypha sp	Unglac —D 1 (1–s)
Acalypha virginica	Glac —J 1(2–s), Unglac —D 2(17–s)
Actinomeris alternifolius	Unglac —D 2(1 5 cc)
Ambrosia artemisiifolia	Glac —J 2(6cc), Unglac —N 6(71 0cc), D 16 (83 8cc), J 2(7 8cc)
Anagallis arvensis	Unglac —J 1(12–s)
Asclepias sp	Unglac —N 1(1–s), D 4(1 5cc)
Avena sativa	Glac —A 1(9 0cc)
Bidens aristosa	Unglac —N 1(1–s), D 2(24–s)
Bromus secalinus	Unglac —N 1(7cc)
Celastrus scandens	Unglac —D 2(2cc)
Cerastium sp	Unglac —D 1(1–s)
Cerastium vulgatum	Glac —A 1(7–s)
Compositae	Glac —J 1(1–s)
Desmodium sp	Unglac —N 4(8 0cc), D 4(2 1cc), F 6(1 0cc)
Digitaria ischaemum	Unglac —D 2(4–s)
Euphorbia corollata	Unglac —N 1(1–s)
Galium sp (green vegetative)	Unglac —D 2(2 2cc)
Geum sp	Unglac —D 1(2–s)
Glycine max	Glac —M 2(10 0cc)
Impatiens sp	Unglac —N 3(2cc), D 7(13 9cc)
Leersia oryzoides	Unglac —D 1(3cc)
Lespedeza sp	Unglac —D 3(9–s)
Lespedeza stipulacea	Unglac —J 5(26 9cc), F 1(6cc)
Lespedeza striata	Unglac —F 1(2cc)
Oxalis sp	Glac —A 1(2–s), J 1(1–s), Unglac – D 1(1–s)
Oxalis sp (green vegetative)	Unglac —F 1(t)
Panicum capillare	Glac —N 2(2cc), Unglac —N 1(1–s), D 3(1 1cc)
Panicum sp	Unglac —N 4(1 1cc) D 5(3cc), F 2(2–s)
Paspalum laeve	Unglac —N 1(6–s), D 1(3–s)
Paspalum sp	Unglac —N 3(3cc), D 1(1–s), J 1(1–s)
Physalis sp	Unglac —N 1(20–s)
Polygonum aviculare	Glac —N 1(1–s)
P dumetorum	Unglac —N 1(4cc), D 2(1cc)
P hydropiper	Unglac —D 1(5cc)
P pennsylvanicum	Unglac —N 1(1–s), D 5(8 9cc)
P persicaria	Glac —A 1(6–s), Unglac —D 3(4cc)
P punctata	Unglac —N 1(3–s)
Portulaca oleracea	Glac —A 1(30–s)
Potentilla sp	Unglac —D 1(1–s)
Prunus serotina	Unglac —D 1(4 0cc)
Quercus sp	Unglac —D 3(6 4cc), F 2(15 0cc)

---

[2] Glac and unglac refer to quail collected in glaciated and unglaciated Ohio, respectively Letters A, O, D, J, F and M refer to the months of August, October, December, January, February and March, respectively The number preceding the brackets refers to the number of specimens examined in which the particular material was found Symbols in brackets refer to the total amount in the crops for that particular month, either as a number of seeds (–s), trace (t), or number of cc (–cc) The number within the brackets that pertains to animal material refers to the number of different individuals All animal material except where otherwise indicated refers to adult forms

Example Glac -D 2(4–s)

Two specimens collected in glaciated Ohio in December contained a total of four seeds

Scientific names from

Britton, W E 1920 Check list of the insects of Connecticut State Geological and Natural History Survey, Public Document No 47

Schaffner, J H 1914 Catalog of Ohio vascular plants Ohio Biological Survey, Bulletin Number 2

TABLE 1—*Continued*

Rhus copallina	Unglac —D 4(2 9cc), F 1(3 5cc)
Robinia pseudo-acacia	Unglac —D 1(3–s)
Rubus sp	Glac —A 1(3–s)
Rumex acetosella	Glac —J 1(7cc), M 1(1cc), Unglac —N 1(7–s), D 1(2–s)
Rumex acetosella (green vegetative)	Unglac —D 3(1cc), F 1(t)
Sassafras sassafras	Unglac —D 4(7cc)
Setaria glauca	Glac —J 2(4cc), Unglac —D 1(3–s), J 2(1 3cc)
Sida spinosa	Unglac —D 1(1–s)
Trifolium pratense ,	Unglac —D 1(10–s)
Trifolium repens (green vegetative)	Unglac —N 3(t), D 2(t) J 2(t), F 1(1cc)
Trifolium sp	Unglac —N 1(1–s), D 1(1–s)
Triticum aestivum	Unglac —N 1(2–s), D 1(1–s), J 1(4–s)
Vitis sp	Unglac —N 1(1 5cc) D 5(17 2cc)
Zea Mays	Glac —N 2(1 0cc), Unglac —N 2(16 1cc), D 6 (6 6cc)
Zea mays (sweet)	Glac —J 1(6 5cc)
Unknown	
Fruit skin	Unglac —J 1(t)
Tuber-like root stocks of grass (green)	Unglac —D 1(1cc)
Twig	Unglac —D 1(2cc)
Green vegetative material	Glac —A 1(t), Unglac —N 2(t), D 4(1cc), F 3(t)
II ANIMAL MATERIAL	
Acrididae	Unglac —N 3(4)
Agallia sp	Glac —J 1(1)
Aphididae	Unglac —N 1(1) J 1(t of 8)
Arachnida (spider)	Unglac —D 2(4)
Carabidae	Unglac —N 1(1)
Carabidae larva	Unglac —N 4(14)
Cercopidae	Glac —A 1(1) Unglac —N 1(1), D 1(2)
Chalepus dorsalis	Unglac —D 2(4)
Chrysomelidae	Glac —A 1(2) Unglac —N 1(1) D 1(3)
Cicadellidae	Unglac —N 1(1) D 1(1)
Elachistidae	Unglac —N 1(1)
Coleoptera larva	Unglac —N 2(2)
Corsicus	Unglac —N 1(1)
Curculionidae	Unglac —N 1(1)
Elateridae	Glac —A 1(1)
Formicidae	Unglac —N 1(2)
Gastropoda (slug)	Unglac —N 1(2)
Gastropoda (snail)	Unglac —N 1(2), D 1(2)
Hymenoptera	Unglac —N 1(1)
Lepidoptera larva	Unglac —N 1(1)
Lygus pratensis	Glac —A 1(1)
Staphylinidae	Unglac —N 1(1)
Sawfly larva	Glac A 1(15)
Unknown	Unglac —N 1(1)
III MISCELLANEOUS	
Debris	Unglac —N 2(6cc) D 4(2 4cc), J 1(1cc)
Grit	Glac —J 1(t) Unglac —N 1(t) D 2(5cc), F 1(t)

TABLE II

CONTENTS OF QUAIL CROPS FROM TRAPPED SPECIMENS

I PLANT MATERIAL	
Ambrosia artemisiifolia	Glac —F 1(1-2)
Bidens sp	Glac —D 2(2–s)
Cryptotaenia canadensis	Glac —F 3(2cc)
Cyperus sp (green vegetative)	Glac —D 1(t)
Desmodium sp	Glac —D 5(6cc)
Digitaria sanguinalis	Glac —D 1(1–s)
Festuca nutans	Glac —F 1(3–s)

TABLE II—*Continued*

Fraxinus sp	Glac —D 1(2-s)
Geum sp	Glac —F 1(3-s)
Maclura pomifera	Glac —D 1(1-s)
Oxalis sp	Glac —O 1(1-s)
Panicum capillare	Glac —D 1(3-s) F 1(1-s)
Polygonum convolvulus	Glac — N 1(1-s)
Polygonum persicaria	Glac —F 2(2-s)
Potentilla sp (green vegetative)	Glac —F 1(t)
Rumex acetosella (green vegetative)	Glac —N 1(t)
Solanum nigrum	Glac —O 1(10-s)
Setaria glauca	Glac —F 3(2cc)
Setaria viridis	Glac —O 1(1-s)
Trifolium repens (green vegetative)	Glac —D 1(t)
Viola sp	Glac —O 5(7cc)
Vitis sp	Glac —O 1(3-s)
Unknown	
Green vegetative material	Glac —O 1(t) N 1(t) F 3(t)
II ANIMAL MATTER	
Acrididae	Glac —O 1(3) N 1(1)
Arachnida (spider)	Glac — F 1(t-1)
Carabidae	Glac —D 1(3)
Gastropoda (snail)	Glac —O 1(2)
Hemiptera nymph (?)	Glac —O 1(1)
Ichneumonidae	Glac —F 1(t-1)
III MISCELLANEOUS	
Grit	Glac —D 1(t)

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THE OHIO JOURNAL OF SCIENCE

VOLUME L—1950

GLENN W BLAYDES, Editor in-Chief

PUBLISHED AT COLUMBUS, OHIO, BY THE
OHIO STATE UNIVERSITY
and the
OHIO ACADEMY OF SCIENCE

THE OHIO JOURNAL OF SCIENCE

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THE OHIO JOURNAL OF SCIENCE

Is published jointly by the Ohio State University and the
Ohio Academy of Science

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PUBLICATION DATES

of

The Ohio Journal of Science

Volume L 1950

January issue	February 7 1950
March issue	March 15 1950
May issue	May 26 1950
July issue	July 26 1950
September issue	October 6 1950
November issue	November 30 1950

THE OHIO JOURNAL OF SCIENCE

VOL L JANUARY, 1950 No 1

A CHECK LIST OF THE BIRDS OF OHIO, WITH THE MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO

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The field identification of birds is greatly facilitated if the observer knows what birds are apt to occur at any given time and place Since previous check lists (Trautman 1935a, Borror, 1941) have been in such demand and since a number of new species have been added to both the state list and the central Ohio list in the last several years it has seemed advisable to bring these lists up to date

The writer is particularly indebted to Dr Edward S Thomas of the Ohio State Archaeological and Natural History Museum, Columbus, Ohio and to Mr Milton B Trautman, of the Franz Theodore Stone Laboratory, Put-in-Bay Ohio for their suggestions and criticisms during the preparation of this paper, and to Dr Thomas for placing the facilities of the Ohio State Museum at the writer's disposal

CHECK LIST OF THE BIRDS OF OHIO

The following list is by species, with comments on the status of subspecies The species starred (*) have been recorded from central Ohio, and are included in the table in the latter part of this paper the status of these species in the state can be inferred from data given in the table The species in the list are grouped into five categories I, the main list of species based on specimens, II, a hypothetical list, either based on old records of specimens that cannot now be located, or on sight records, III, species formerly occurring in Ohio but now extirpated (at least in Ohio), IV, exotics, either escaped cage birds, or species that have been introduced and are still of very local distribution, and V others, including hybrids, prehistoric species, and species that were introduced into Ohio at one time but failed to become established

In the case of casual or accidental species that are included in the main list on the basis of one or a few specimens, the location of the specimens (based on data in the literature, except for specimens in the Ohio State Museum), is indicated as follows CMNH—Cleveland Museum of Natural History, CMP—Carnegie Museum, Pittsburgh, CSNH--Cincinnati Society of Natural History, OM—Oberlin Museum, OSM—Ohio State Museum, Columbus UCM—University of Cincinnati Museum, UM—Museum of Zoology, University of Michigan, and USNM—United States National Museum Washington, D C

The nomenclature followed is that of the Fourth Edition of the American Ornithologists' Union Check-List (1931), and Supplements 19–24 (1944–1949) Forms that are either not recognized by the American Ornithologists' Union or are on the A O U hypothetical list (including hybrids and exotics) are indicated by a dagger (†)

I. Species Based on Specimens

*1 Common Loon *Gavia immer* (Brünnich) Both the Lesser Common Loon (*G i elasson* Bishop) and the Greater Common Loon (*G i immer*) have been reported from Ohio but according to Trautman (1935b) the lesser common loon is probably the more common subspecies in the state

2 Pacific Loon *Gavia arctica pacifica* (Lawrence) Casual, several records including a specimen taken at Ashtabula 2/19/09 (Jones 1918) (OM)

*3 Red throated Loon, *Gavia stellata* (Pontoppidian) Rare

*4 Holboell s Grebe, *Colymbus grisegena holbollii* (Reinhardt)

*5 Horned Grebe *Colymbus auritus* Linnaeus

6 Eared Grebe *Colymbus caspicus californicus* (Heermann) Two records Lake Co 4/22/41 (Godfrey 1943b) (CMNH) and South Bass Island 11/29/45 (Trautman 1946) (OSM)

7 Western Grebe *Aechmophorus occidentalis* (Lawrence) One record near Youngstown 10/30/13 (Fordyce 1913) (CMP)

*8 Pied billed Grebe *Podilymbus podiceps podiceps* (Linnaeus)

9 Black capped Petrel *Pterodroma hasitata* (Kuhl) One record near Cincinnati 10 5/98 (Lindahl 1899) (CSNH)

10 Leach s Petrel *Oceanodroma leucorhoa leucorhoa* (Vieillot) One record Dayton 5/16/29 (Blincoe 1930) (OSM)

*11 White Pelican, *Pelecanus erythrorhynchus* Gmelin Rare

12 Gannet *Moris bassana* (Linnaeus) Several records along Lake Erie in winter (Hadeler 1926 Mayfield 1948), including a specimen from Lucas Co 12/22/47 (OSM)

*13 Northern Double crested Cormorant *Phalacrocorax auritus auritus* (Lesson)

14 Water turkey *Anhinga anhinga leucogaster* (Vieillot) One record Lowell Washington Co Nov 1885 (Jones 1905) (OSM)

*15 Eastern Great Blue Heron *Ardea herodias herodias* Linnaeus

*16 American Egret *Casmerodius albus egretta* (Gmelin)

*17 Snowy Egret *Leucophoyx thula thula* (Molina)

*18 Little Blue Heron *Florida caerulea caerulea* (Linnaeus) Practically all the Ohio records are of immature (white) birds

*19 Eastern Green Heron, *Butorides virescens virescens* (Linnaeus)

*20 Black crowned Night Heron *Nycticorax nycticorax hoactli* (Gmelin)

*21 Yellow crowned Night Heron *Nyctanassa violacea* (Linnaeus) Several records some nesting mostly from northern and northwestern Ohio (Walker 1928b Bruce 1931 Hicks 1935a Walker 1940, Price 1946a Mayfield 1949)

*22 American Bittern *Botaurus lentiginosus* (Montagu)

*23 Eastern Least Bittern *Ixobrychus exilis exilis* (Gmelin)

24 Wood Ibis *Mycteria americana* Linnaeus Three records one at Cleveland in 1879 (Wheaton 1882) and two at Wilmington 7/23/09 (Jones 1918) and 5/5/46 (Hazard 1947) (OSM)

25 Eastern Glossy Ibis, *Plegadis falcinellus falcinellus* (Linnaeus) A few northern Ohio records (Kirtland 1850, Mayfield 1943a and 1947, Campbell 1944), and one record from southern Ohio (a bird collected at Grant Lake in Brown Co 10/1/49 by Ronald Austing)

*26 Whistling Swan *Cygnus columbianus* (Ord)

*27 Common Canada Goose *Branta canadensis canadensis* (Linnaeus)

*28 American Brant *Branta bernicla hrota* (Müller) Several Ohio records (Fisher 1907 Jones 1908, Hadeler 1930, Trautman 1940) a skin (OSM), "Lake Erie Ohio, 11/10/74

29 Barnacle Goose, *Branta leucopsis* (Bechstein) One record, Winous Point (Sandusky Bay) 11/5/25 (Aldrich 1932b) (CMNH)

*30 White fronted Goose *Anser albifrons albifrons* (Scopoli) A few Ohio records (Langdon 1879, Wheaton 1882, Hadeler 1930, Ball 1945, Clark 1946), and a skin (OSM) "Fairfield Co , Ohio " without date

*31 Lesser Snow Goose, *Chen hyperborea hyperborea* (Pallas)

*32 Blue Goose, *Chen caerulescens* (Linnaeus)

*33 Mallard, *Anas platyrhynchos platyrhynchos* Linnaeus

*34 Black Duck, *Anas rubripes* Brewster

*35 Gadwall, *Anas strepera* Linnaeus

*36 Pintail, *Anas acuta tzitzihoa* Vieillot

*37 European Teal, *Anas crecca* Linnaeus Recorded from Auglaize Co (Walker 1931) (OSM), Buckeye Lake (Trautman 1932), and Youngstown (Baird 1935)

*38 Green winged Teal *Anas carolinensis* Gmelin

*39 Blue winged Teal *Anas discors* Linnaeus

*40 Cinnamon Teal, *Anas cyanoptera cyanoptera* Vieillot One Ohio record, Buckeye Lake 4/4/95 (Davie 1898) (OSM)

*41 European Widgeon, *Mareca penelope* (Linnaeus)

*42 Baldpate, *Mareca americana* (Gmelin)

*43 Shoveller, *Spatula clypeata* (Linnaeus)

*44 Wood Duck, *Aix sponsa* (Linnaeus)

*45 Redhead *Aythya americana* (Eyton)

*46 Ring necked Duck *Aythya collaris* (Donovan)

*47 Canvasback *Aythya valisineria* (Wilson)

*48 Greater Scaup Duck *Aythya marila nearctica* Stejneger Rare

*49 Lesser Scaup Duck *Aythya affinis* (Eyton)

*50 American Golden eye *Bucephala clangula americana* (Bonaparte)

*51 Buffle head, *Bucephala albeola* (Linnaeus)

*52 Old-squaw *Clangula hyemalis* (Linnaeus)

*53 King Eider *Somateria spectabilis* (Linnaeus) Rare

*54 White winged Scoter, *Melanitta deglandi* (Bonaparte)

*55 Surf Scoter *Melanitta perspicillata* (Linnaeus)

*56 American Scoter *Oidemia nigra americana* Swainson

*57 Ruddy Duck *Oxyura jamaicensis rubida* (Wilson)

*58 Hooded Merganser *Lophodytes cucullatus* (Linnaeus)

*59 American Merganser *Mergus merganser americanus* Cassin

*60 Red breasted Merganser *Mergus serrator serrator* Linnaeus

*61 Eastern Turkey Vulture, *Cathartes aura septentrionalis* Wied

*62 Black Vulture, *Coragyps atratus* (Meyer) Southern Ohio only

*63 Eastern Goshawk, *Accipiter gentilis atricapillus* (Wilson) Rare

*64 Sharp-shinned Hawk *Accipiter striatus velox* (Wilson)

*65 Cooper's Hawk *Accipiter cooperii* (Bonaparte)

*66 Eastern Red tailed Hawk *Buteo jamaicensis borealis* (Gmelin) There are in the literature two Ohio records of the Western Red tailed Hawk *B j calurus* Cassin (Jones 1903 Henninger 1912), but the specimens on which these records are based (OSM) have been determined by Oberholser as *b borealis*

*67 Northern Red-shouldered Hawk *Buteo lineatus lineatus* (Gmelin)

*68 Broad winged Hawk, *Buteo platypterus platypterus* (Vieillot)

*69 American Rough legged Hawk, *Buteo lagopus sancti johannis* (Gmelin)

*70 Harris's Hawk, *Parabuteo unicinctus harrisi* (Audubon) One Ohio record Harrisburg 12/24/17 (Earl 1918) (OM)

*71 Golden Eagle *Aquila chrysaëtos canadensis* (Linnaeus) Rare

*72 Northern Bald Eagle, *Haliaeetus leucocephalus washingtonii* (Audubon)

*73 Marsh Hawk, *Circus cyaneus hudsonius* (Linnaeus)

*74 Osprey, *Pandion haliaetus carolinensis* (Gmelin)

75 Gyrfalcon *Falco rusticolus obsoletus* Gmelin Three Ohio records Fayette Co 1/30/07 (Henninger 1911) (OSM) Wood Co 12/10/42 (Moseley 1943), and Youngstown 4/22/34 (Baird 1934)

*76 Duck Hawk, *Falco peregrinus anatum* Bonaparte Rare

*77 Eastern Pigeon Hawk *Falco columbarius columbarius* Linnaeus

*78 Eastern Sparrow Hawk, *Falco sparverius sparverius* Linnaeus

*79 Eastern Ruffed Grouse, *Bonasa umbellus umbellus* (Linnaeus)

80 Greater Prairie Chicken, *Tympanuchus cupido pinnatus* (Brewster) Formerly fairly common in the state but extirpated by about 1900, in 1933 reintroduced into Marion Co (Trautman 1935c), some recent records from northwestern Ohio (Hicks 1935a and 1935b)

*81 Hungarian Partridge *Perdix perdix perdix* (Linnaeus) Introduced, and very local

*82 Eastern Bob white *Colinus virginianus virginianus* (Linnaeus) According to Aldrich (1946), the bob white that occurs in Ohio is the Interior Bob-white *C v mexicanus* (Linnaeus) †

*83 Ring-necked Pheasant, *Phasianus colchicus* Linnaeus

*84 Sandhill Crane, *Grus canadensis tabida* (Peters) Rare

*85 King Rail *Rallus elegans elegans* Audubon

*86 Virginia Rail, *Rallus limicola limicola* Vieillot

*87 Sora *Porzana carolina* (Linnaeus)

*88 Yellow Rail *Coturnicops novaboracensis novaboracensis* (Gmelin) Rare Bailey (1935) records *C n richi* Bailey† from Canton

*89 Black Rail, *Laterallus jamaicensis pygmaeus* (Blackwall) Rare

*90 Purple Gallinule *Porphyrula martinica* (Linnaeus) Rare

*91 Florida Gallinule *Gallinula chloropus cachinnans* Bangs

*92 American Coot, *Fulica americana americana* Gmelin

*93 Piping Plover *Charadrius melodus* Ord

*94 Semipalmated Plover *Charadrius hiaticula semipalmatus* Bonaparte

95 Wilson s Plover *Charadrius wilsonia wilsonia* Ord One Ohio record Lucas Co 6/17/36 (Campbell 1936d) (OSM)

*96 Killdeer, *Charadrius vociferus vociferus* Linnaeus

*97 American Golden Plover, *Pluvialis dominica dominica* (Muller)

*98 Black bellied Plover, *Squatarola squatarola* (Linnaeus)

*99 Ruddy Turnstone *Arenaria interpres morinella* (Linnaeus)

*100 American Woodcock *Philohela minor* (Gmelin)

101 European Woodcock, *Scolopax rusticola rusticola* Linnaeus One Ohio record Geauga Co 11/6/35 (Aldrich 1936b) (CMNH)

*102 Wilson s Snipe *Capella gallinago delicata* (Ord)

*103 Hudsonian Curlew *Numenius phaeopus hudsonicus* Latham

*104 Upland Plover *Bartramia longicauda* (Bechstein)

*105 Spotted Sandpiper *Actitis macularia* (Linnaeus)

*106 Eastern Solitary Sandpiper *Tringa solitaria solitaria* Wilson

*107 Western Willet *Catoptrophorus semipalmatus inornatus* (Brewster)

*108 Greater Yellowlegs *Totanus melanoleucus* (Gmelin)

*109 Lesser Yellowlegs *Totanus flavipes* (Gmelin)

*110 American Knot, *Calidris canutus rufa* (Wilson) Rare

111 Purple Sandpiper *Erolia maritima* (Brünnich) Several records from northern Ohio (Trautman 1944 (OSM) Doolittle 1916 and 1924b, Hill 1943 Mayfield 1949)

*112 Pectoral Sandpiper *Erolia melanotos* (Vieillot)

*113 White rumped Sandpiper, *Erolia fuscicollis* (Vieillot)

*114 Baird s Sandpiper *Erolia bairdii* (Coues)

*115 Least Sandpiper, *Erolia minutilla* (Vieillot)

*116 Red backed Sandpiper *Erolia alpina pacifica* (Coues)

*117 Dowitcher *Limnodromus griseus* (Gmelin) Most of the Ohio records of this species including those from central Ohio, refer to the Eastern Dowitcher, *L g griseus*, the Long-billed Dowitcher, *L g scolopaceus* (Say), has been recorded from northern Ohio (Campbell and Campbell 1935 (OSM) Hicks 1938b, Campbell 1940)

*118 Stilt Sandpiper, *Micropalama himantopus* (Bonaparte)

*119 Semipalmated Sandpiper, *Ereunetes pusillus* (Linnaeus)

*120 Western Sandpiper *Ereunetes mauri* Cabanis

*121 Buff breasted Sandpiper, *Tryngites subruficollis* (Vieillot) Rare

*122 Marbled Godwit, *Limosa fedoa* (Linnaeus) Rare

*123 Hudsonian Godwit *Limosa haemastica* (Linnaeus) Rare

*124 Ruff, *Philomachus pugnax* (Linnaeus) Two Ohio records Buckeye Lake 11/10/72 (Wheaton 1882) (OSM) and Columbus 4/28/78 (Jones 1903) (OSM)
*125 Sanderling, *Crocethia alba* (Pallas)
126 Avocet, *Recurvirostra americana* (Gmelin) Several Ohio records (Jones 1903 (OSM), Baird 1936 (OSM) Hicks 1937a, Campbell 1940, Mayfield 1944b)
*127 Red Phalarope, *Phalaropus fulicarius* (Linnaeus) Rare
*128 Wilson s Phalarope, *Steganopus tricolor* Vieillot
*129 Northern Phalarope, *Lobipes lobatus* (Linnaeus)
*130 Parasitic Jaeger *Stercorarius parasiticus* (Linnaeus) Rare
*131 Long tailed Jaeger, *Stercorarius longicaudus* Vieillot One Ohio record Buckeye Lake 9/5/28 (Trautman and Walker 1930) (OSM)
132 Glaucous Gull, *Larus hyperboreus hyperboreus* Gunnerus Recorded along Lake Erie (Campbell and Campbell 1934a Hicks 1936 (OSM) Skaggs 1937 Campbell 1940 (OSM), Mayfield 1943b (OSM))
*133 Great Black backed Gull *Larus marinus* Linnaeus Most of the Ohio records are from Lake Erie
*134 American Herring Gull, *Larus argentatus smithsonianus* Coues
*135 Ring billed Gull *Larus delawarensis* Ord
*136 Franklin s Gull *Larus pipixcan* Wagler Rare
*137 Bonaparte s Gull *Larus philadelphia* (Ord)
*138 Atlantic Kittiwake, *Rissa tridactyla tridactyla* (Linnaeus) Casual
*139 Sabine s Gull, *Xema sabini sabini* (Sabine) Casual
*149 Forster s Tern, *Sterna forsteri* Nuttall Rare
*141 Common Tern *Sterna hirundo hirundo* Linnaeus
*142 Interior Least Tern *Sterna albifrons athalassos* Burleigh and Lowery Casual several records from Lucas Co (Campbell 1935 and 1940) (OSM), one record from central Ohio (Trautman 1940) and one record from Hamilton Co (Langdon 1879) (OSM)
*143 Caspian Tern *Hydroprogne caspia* (Pallas)
*144 Black Tern *Chlidonias niger surinamensis* (Gmelin)
145 Brünnich s Murre *Uria lomvia lomvia* (Linnaeus) Several Ohio records mostly from Lake Erie (Davie 1898 (OSM) Jones 1903 Sim 1908 Moseley 1908 Doolittle 1924a, Hicks 1935b)
*146 Domestic Pigeon *Columba livia* Gmelin
*147 Eastern Mourning Dove *Zenaidura macroura carolinensis* (Linnaeus)
*148 Yellow billed Cuckoo, *Coccyzus americanus americanus* (Linnaeus)
*149 Black billed Cuckoo, *Coccyzus erythrophthalmus* (Wilson)
*150 Barn Owl *Tyto alba pratincola* (Bonaparte)
*151 Eastern Screech Owl *Otus asio naevius* (Gmelin)
*152 Great Horned Owl *Bubo virginianus virginianus* (Gmelin)
*153 Snowy Owl *Nyctea sandiaca* (Linnaeus) Rare winter visitor
*154 Northern Barred Owl, *Strix varia varia* Barton
*155 Long eared Owl *Asio otus wilsonianus* (Lesson)
*156 Short eared Owl *Asio flammeus flammeus* (Pontoppidian)
*157 Saw whet Owl *Aegolius acadicus acadicus* (Gmelin)
158 Chuck will s widow, *Caprimulgus carolinensis* Gmelin Reported from southern Ohio (Thomas 1932 (OSM) Blincoe 1933, Hicks 1935a)
*159 Eastern Whip-poor-will *Caprimulgus vociferus vociferus* Wilson
*160 Nighthawk *Chordeiles minor* (Forster) Most of the Ohio records including those from central Ohio refer to the Eastern Nighthawk *C m minor* but Sennett s Nighthawk *C m sennetti* Coues has been reported from Pike Co (Hicks 1938c) (OSM), and from Cleveland (Aldrich 1936c) (CMNH)
*161 Chimney Swift, *Chaetura pelagica* (Linnaeus)
*162 Ruby throated Hummingbird *Archilochus colubris* (Linnaeus)
*163 Eastern Belted Kingfisher, *Megaceryle alcyon alcyon* (Linnaeus)
*164 Northern Flicker, *Colaptes auratus luteus* Bangs

*165 Pileated Woodpecker, *Dryocopus pileatus* (Linnaeus) The subspecific status of the Ohio birds is somewhat questionable, but those in central Ohio are probably the Southern Pileated Woodpecker, *D p pileatus* (Trautman 1940) The Northern Pileated Woodpecker, *D p abieticola* (Bangs), has been reported from Ohio (Hicks 1935a and 1935b, Campbell 1940) (OSM)

*166 Eastern Red bellied Woodpecker *Centurus carolinus carolinus* (Linnaeus)

*167 Red headed Woodpecker, *Melanerpes erythrocephalus erythrocephalus* (Linnaeus)

*168 Yellow bellied Sapsucker, *Sphyrapicus varius varius* (Linnaeus)

*169 Eastern Hairy Woodpecker, *Dendrocopos villosus villosus* (Linnaeus)

*170 Downy Woodpecker, *Dendrocopos pubescens* (Linnaeus) Most of the Ohio records of this species refer to the Northern Downy Woodpecker *D p medianus* (Swainson), there is one Ohio record of the Southern Downy Woodpecker, *D p pubescens* Lawrence Co 5/2/36 (Hicks 1939) (OSM)

*171 Northern Red cockaded Woodpecker *Dendrocopos borealis borealis* (Vieillot) One Ohio record Columbus 3/15/72 (Jones 1903) (OSM)

*172 Eastern Kingbird, *Tyrannus tyrannus* (Linnaeus)

*173 Arkansas Kingbird, *Tyrannus verticalis* Say Several Lucas Co records (Campbell 1940) (OSM), one Hamilton Co record (Kemsies 1948), and two central Ohio records

*174 Northern Crested Flycatcher *Myiarchus crinitus boreus* Bangs

*175 Eastern Phoebe *Sayornis phoebe* (Latham)

*176 Yellow bellied Flycatcher, *Empidonax flaviventris* (Baird and Baird)

*177 Acadian Flycatcher, *Empidonax virescens* (Vieillot)

*178 Alder Flycatcher, *Empidonax traillii traillii* (Audubon)

*179 Least Flycatcher, *Empidonax minimus* (Baird and Baird)

*180 Wood Pewee *Contopus virens* (Linnaeus)

*181 Olive sided Flycatcher, *Nuttallornis borealis* (Swainson)

*182 Horned Lark, *Eremophila alpestris* (Linnaeus) Three subspecies occur in Ohio the Northern Horned Lark *E a alpestris* the Prairie Horned Lark, *E a praticola* (Henshaw), and Hoyt s Horned Lark *E a hoyti* (Bishop) The latter subspecies is relatively rare in Ohio (See Walker and Trautman 1936)

*183 Tree Swallow, *Iridoprocne bicolor* (Vieillot)

*184 Bank Swallow, *Riparia riparia riparia* (Linnaeus)

*185 Rough winged Swallow, *Stelgidopteryx ruficollis serripennis* (Audubon)

*186 Barn Swallow, *Hirundo rustica erythrogaster* Boddaert

*187 Northern Cliff Swallow *Petrochelidon pyrrhonota albifrons* (Rafinesque)

*188 Purple Martin *Progne subis subis* (Linnaeus)

*189 Northern Blue Jay *Cyanocitta cristata bromia* Oberholser

*190 Eastern Crow *Corvus brachyrhynchos brachyrhynchos* Brehm

191 Southern Raven, *Corvus corax europhilus* Oberholser Once a fairly common bird in Ohio apparently extirpated in the state about fifty years ago, but it occurs rarely today and may be on the increase One wintered at Put in Bay a few years ago

*192 Black capped Chickadee *Parus atricapillus* Linnaeus The records of this species from central and southern Ohio refer to the Appalachian Black capped Chickadee *P a practicus* (Oberholser), those from northern Ohio refer to this race to the Eastern Black capped Chickadee, *P a atricapillus* or to intermediates between *atricapillus* and *practicus* (Oberholser 1937 Duvall 1945)

*193 Northern Carolina Chickadee, *Parus carolinensis extimus* Todd and Sutton

194 Hudsonian Chickadee *Parus hudsonicus hudsonicus* Forster One Ohio record, Turtle Island (on Ohio-Michigan line) 11/6/43 (Mayfield 1944a) (UM)

*195 Tufted Titmouse, *Parus bicolor* Linnaeus

*196 Northern White breasted Nuthatch, *Sitta carolinensis cookei* Oberholser Aldrich (1944a) calls this subspecies the Eastern White breasted Nuthatch

*197 Red breasted Nuthatch, *Sitta canadensis* Linnaeus

*198 Northern Brown Creeper, *Certhia familiaris americana* Bonaparte

*199 House Wren, *Troglodytes aëdon* Vieillot Most of the Ohio records of this species refer to the Ohio House Wren *T a baldwini* Oberholser, there is one Ohio record of the

Eastern House Wren, *T a aëdon*, Cleveland 5/19/33 (Oberholser 1934) (CMNH) Oberholser (1934) and Aldrich (1936a) call this species *T domesticus* (Wilson) †

*200 Eastern Winter Wren, *Troglodytes troglodytes hiemalis* Vieillot

*201 Appalachian Bewick s Wren, *Thryomanes bewickii altus* Aldrich

*202 Northern Carolina Wren, *Thryothorus ludovicianus ludovicianus* (Latham) According to Lowery (1940) the Carolina Wren in Ohio is *T l carolinianus* (Wilson) according to Godfrey (1946), it is *T l ludovicianus*

*203 Prairie Marsh Wren *Telmatodytes palustris dissaëptus* (Bangs)

*204 Short billed Marsh Wren *Cistothorus platensis stellaris* (Naumann)

*205 Eastern Mockingbird, *Mimus polyglottos polyglottos* (Linnaeus)

*206 Catbird *Dumetella carolinensis* (Linnaeus)

*207 Eastern Brown Thrasher, *Toxostoma rufum rufum* (Linnaeus)

*208 Robin *Turdus migratorius* Linnaeus Most of the Ohio records of this species refer to the Eastern Robin *T m migratorius* The Southern Robin *T m achrusterus* (Batchelder), has been recorded in southern Ohio (Henninger 1907, Kemsies 1948 Kemsies and Dreyer 1948 (UCM)) and the Black backed Robin, *T m nigrideus* Aldrich and Nutt has been recorded in Geauga Co (Aldrich and Nutt 1939) (CMNH)

*209 Wood Thrush, *Hylocichla mustelina* (Gmelin)

*210 Eastern Hermit Thrush *Hyocichla guttata faxoni* Bangs and Penard There is one Ohio record of the Cascade Hermit Thrush *H g oromela* Oberholser† Bay Point 4/7/32 (Aldrich 1936a) (CMNH)

*211 Olive backed Thrush *Hylocichla ustulata swainsoni* (Tschudi)

*212 Gray cheeked Thrush *Hylocichla minima minima* (Lafresnaye) There is one Ohio record of Bicknell s Thrush *H m bicknelli* Ridgway Lucas Co 9/29/33 (Campbell 1934) (OSM)

*213 Veery *Hylocichla fuscescens* (Stephens) The Ohio birds of this species represent both the Veery (*H f fuscescens*) and the Willow Thrush (*H f salicicola* Ridgway) and intermediates between the two These forms probably occur in about equal numbers in the state

*214 Eastern Bluebird *Sialia sialis sialis* (Linnaeus)

*215 Blue gray Gnatcatcher *Polioptila caerulea caerulea* (Linnaeus)

*216 Eastern Golden crowned Kinglet *Regulus satrapa satrapa* Lichtenstein

*217 Eastern Ruby crowned Kinglet *Regulus calendula calendula* (Linnaeus)

*218 American Pipit *Anthus spinoletta rubescens* (Tunstall)

*219 Cedar Waxwing *Bombycilla cedrorum* Vieillot

*220 Northern Shrike *Lanius excubitor borealis* Vieillot Casual winter visitor

*221 Migrant Shrike *Lanius ludovicianus migrans* Palmer

*222 Starling *Sturnus vulgaris vulgaris* Linnaeus

*223 Northern White eyed Vireo, *Vireo griseus novaboracensis* (Gmelin)

*224 Yellow throated Vireo, *Vireo flavifrons* Vieillot

*225 Blue headed Vireo *Vireo solitarius* (Wilson) The migrants of this species appear to include both the typical form (*V s solitarius*) and the Mountain Vireo (*V s alticola* Brewster) as the latter is the form which nests in northwestern Ohio

*226 Red-eyed Vireo *Vireo olivaceus* (Linnaeus)

*227 Philadelphia Vireo *Vireo philadelphicus* (Cassin)

*228 Eastern Warbling Vireo *Vireo gilvus gilvus* (Vieillot)

*229 Black and White Warbler *Mniotilta varia* (Linnaeus)

*230 Prothonotary Warbler *Protonotaria citrea* (Boddaert)

231 Swainson s Warbler *Limnothlypis swainsonii* (Audubon) One Ohio record, Lawrence Co 6/21/47 (Green 1947) (OSM)

*232 Worm-eating Warbler *Helmitheros vermivorus* (Gmelin)

*233 Golden winged Warbler, *Vermivora chrysoptera* (Linnaeus)

*234 Blue winged Warbler, *Vermivora pinus* (Linnaeus)

*235 Tennessee Warbler, *Vermivora peregrina* (Wilson)

*236 Orange-crowned Warbler, *Vermivora celata celata* (Say)

*237 Nashville Warbler *Vermivora ruficapilla ruficapilla* (Wilson)

*238 Northern Parula Warbler, *Parula americana pusilla* (Wilson) Some birds from central Ohio are intermediate between *P a pusilla* and *P a americana* (Linnaeus) (the Southern Parula Warbler) (Trautman 1940)

*239 Eastern Yellow Warbler *Dendroica petechia aestiva* (Gmelin) The Newfoundland Yellow Warbler, *D p amnicola* Batchelder has been recorded from Lebanon (Kemsies and Dreyer 1948) (UCM)

*240 Magnolia Warbler *Dendroica magnolia* (Wilson)

*241 Cape May Warbler, *Dendroica tigrina* (Gmelin)

*242 Black throated Blue Warbler, *Dendroica caerulescens caerulescens* (Gmelin)

*243 Myrtle Warbler, *Dendroica coronata coronata* (Linnaeus) There is one Ohio record of the Alaska Myrtle Warbler, *D c hooveri* McGregor 15 miles north of Cincinnati Oct 1948 (Kemsies personal communication)

*244 Black throated Green Warbler, *Dendroica virens virens* (Gmelin)

*245 Cerulean Warbler, *Dendroica cerulea* (Wilson)

*246 Blackburnian Warbler *Dendroica fusca* (Müller)

*247 Sycamore Warbler *Dendroica dominica albilora* Ridgway Casual north of central Ohio

*248 Chestnut-sided Warbler, *Dendroica pennsylvanica* (Linnaeus)

*249 Bay breasted Warbler *Dendroica castanea* (Wilson)

*250 Black-poll Warbler *Dendroica striata* (Forster)

*251 Northern Pine Warbler *Dendroica pinus pinus* (Wilson)

*252 Kirtland s Warbler *Dendroica kirtlandii* (Baird) Rare

*253 Northern Prairie Warbler, *Dendroica discolor discolor* (Vieillot)

*254 Palm Warbler *Dendroica palmarum* (Gmelin) Most of the Ohio records of this species refer to the Western Palm Warbler, *D p palmarum* there are four records from northern Ohio of the Yellow Palm Warbler *D p hypochrysea* Ridgway Oberlin 4/16/92 (McCormick 1892) (OM), Lucas Co 10/25/35 (Campbell 1936b) (OSM) South Bass Island 4/4/44 (Mayfield 1944b) (OSM) and Put in Bay 5/1/49 (Mayfield 1949)

*255 Eastern Ovenbird *Seiurus aurocapillus aurocapillus* (Linnaeus)

*256 Water-Thrush *Seiurus novaboracensis* (Gmelin) Both the Northern Water-Thrush *S n novaboracensis* and Grinnell's Water-Thrush, *S n notabilis* Ridgway occur in Ohio but the latter subspecies appears to be the more common migrant and is also the breeding form (Aldrich 1934 Trautman 1940)

*257 Louisiana Water-Thrush *Seiurus motacilla* (Vieillot)

*258 Kentucky Warbler *Oporornis formosus* (Wilson)

*259 Connecticut Warbler *Oporornis agilis* (Wilson)

*260 Mourning Warbler *Oporornis philadelphia* (Wilson)

*261 Northern Yellowthroat *Geothlypis trichas brachydactyla* (Swainson) There is one Ohio record of the Maryland Yellowthroat, *G t trichas* (Linnaeus), Cincinnati 7/20/07 (Kemsies and Dreyer 1948) (UCM)

*262 Yellow breasted Chat *Icteria virens virens* (Linnaeus)

*263 Hooded Warbler, *Wilsonia citrina* (Boddaert)

*264 Wilson s Warbler *Wilsonia pusilla pusilla* (Wilson)

*265 Canada Warbler *Wilsonia canadensis* (Linnaeus)

*266 American Redstart *Setophaga ruticilla ruticilla* (Linnaeus) Four specimens of the Northern Redstart, *S r tricolora* (Muller) have been taken near Cincinnati, one in Oct 1948 and three in the fall of 1949 (Kemsies, personal communication)

*267 English Sparrow, *Passer domesticus domesticus* (Linnaeus)

*268 Bobolink, *Dolichonyx oryzivorus* (Linnaeus)

*269 Eastern Meadowlark *Sturnella magna magna* (Linnaeus)

*270 Western Meadowlark, *Sturnella neglecta* Audubon Rare

*271 Yellow headed Blackbird, *Xanthocephalus xanthocephalus* (Bonaparte) Rare

*272 Redwing *Agelaius phoeniceus* (Linnaeus) Most of the Ohio records of this species refer to the Eastern Redwing *A p phoeniceus* The Giant Redwing *A p arctolegus* Oberholser, has been recorded from central Ohio (Trautman 1935c) (OSM) and northern Ohio (Campbell and Campbell 1934b (OSM), Campbell 1936a, Aldrich 1932a)

*273 Orchard Oriole, *Icterus spurius* (Linnaeus)

*274 Baltimore Oriole, *Icterus galbula* (Linnaeus)

*275 Rusty Blackbird, *Euphagus carolinus* (Müller)

276 Brewer's Blackbird *Euphagus cyanocephalus* (Wagler) Recorded only from Lucas Co (Campbell 1936e (OSM) and 1940, Walker 1942, Mayfield 1949)

*277 Bronzed Grackle, *Quiscalus quiscula versicolor* Vieillot

*278 Eastern Cowbird, *Molothrus ater ater* (Boddaert)

*279 Scarlet Tanager, *Piranga olivacea* (Gmelin)

*280 Summer Tanager, *Piranga rubra rubra* (Linnaeus) Casual north of central Ohio

*281 Eastern Cardinal, *Richmondena cardinalis cardinalis* (Linnaeus)

*282 Rose-breasted Grosbeak, *Pheucticus ludovicianus* (Linnaeus)

283 Eastern Blue Grosbeak *Guiraca caerulea caerulea* (Linnaeus) Reported breeding in Adams Co (Hicks 1945) (OSM), several sight records from northern Ohio (Campbell 1940, Wharram 1921, Doolittle 1926)

*284 Indigo Bunting, *Passerina cyanea* (Linnaeus)

*285 Dickcissel, *Spiza americana* (Gmelin)

*286 Eastern Evening Grosbeak, *Hesperiphona vespertina vespertina* (Cooper) Irregular winter visitor

*287 Eastern Purple Finch *Carpodacus purpureus purpureus* (Gmelin)

288 Newfoundland Pine Grosbeak *Pinicola enucleator eschatosus* Oberholser Several winter records from northern Ohio (Jones 1903, Doolittle 1919, Fordyce 1916, Van Tyne 1934 (OSM) Campbell 1940 (OSM))

289 Hoary Redpoll, *Acanthis hornemanni exilipes* (Coues) Two Ohio records Lucas Co 3/16/31 (OSM) and 3/29/31 (seen) (Hicks 1934a)

*290 Redpoll, *Acanthis flammea* (Linnaeus) Most of the Ohio records of this species refer to the Common Redpoll *A f flammea*, the Greater Redpoll, *A f rostrata* (Coues), has been reported from Lucas Co (Trautman 1935c (OSM) Campbell 1940)

*291 Pine Siskin, *Spinus pinus pinus* (Wilson)

*292 Eastern Goldfinch, *Spinus tristis tristis* (Linnaeus)

*293 Eastern Red Crossbill, *Loxia curvirostra minor* (Brehm) Rare winter visitor

*294 White winged Crossbill *Loxia leucoptera leucoptera* Gmelin Rare winter visitor

*295 Red eyed Towhee *Pipilo erythrophthalmus erythrophthalmus* (Linnaeus)

296 Lark Bunting *Calamospiza melanocorys* Stejneger A few northern Ohio records (Skaggs 1945 (CMNH) Hicks 1946 (OSM))

*297 Savannah Sparrow *Passerculus sandwichensis* (Gmelin) Five subspecies have been recorded from Ohio the Eastern Savannah Sparrow, *P s savanna* (Wilson) (OSM), the Labrador Savannah Sparrow *P s labradorius* Howe (OSM), the Churchill Savannah Sparrow, *P s oblitus* Peters and Griscom (OSM) the Southeastern Savannah Sparrow *P s mediogriseus* Aldrich† (Aldrich 1940) (CMNH), and the Nevada Savannah Sparrow *P s nevadensis* Grinnell (CMNH) According to Aldrich (1940), the breeding form (in northeastern Ohio) is the Southeastern Savannah Sparrow and the other subspecies are migrants

*298 Eastern Grasshopper Sparrow, *Ammodramus savannarum pratensis* (Vieillot)

*299 Leconte's Sparrow, *Passerherbulus caudacutus* (Latham) Rare

*300 Western Henslow's Sparrow *Passerherbulus henslowii henslowii* (Audubon)

*301 Sharp-tailed Sparrow, *Ammospiza caudacuta* (Gmelin) Most of the Ohio records of this species refer to Nelson's Sparrow, *A c nelsoni* (Allen), there is one Ohio record of the Acadian Sharp-tailed Sparrow, *A c subvirgata* (Dwight), Lake Co 9/20/31 (Aldrich 1936a) (CMNH)

*302 Eastern Vesper Sparrow, *Pooecetes gramineus gramineus* (Gmelin)

*303 Eastern Lark Sparrow, *Chondestes grammacus grammacus* (Say) Rare in central and northern Ohio

*304 Bachman's Sparrow, *Aimophila aestivalis bachmanii* (Audubon) Occurs only in central and southern Ohio

*305 Slate-colored Junco, ***Junco hyemalis hyemalis*** (Linnaeus) There are two Ohio records of the Intermediate (or Cassiar) Junco ***J h connectans*** Coues (= ***J h cismontanus*** Dwight) Lucas Co 3/31/35 (Campbell 1936c) (OSM) and Columbus 4/4/46 (OSM)

*306 Oregon Junco, ***Junco oreganus*** (Townsend) This species has been reported from Lucas Co (Campbell 1937a and 1940), Butler Co (Hefner and Mattox 1943), Akron (Mayfield 1944b 1948 and 1949), South Bass Island (OSM) and Columbus (OSM) Campbell records the subspecies as ***shufeldti*** Coale (Shufeldt s Junco), but the specimens in the Ohio State Museum from Lucas Co , South Bass Island and Columbus are labelled by A H Miller as the subspecies ***montanus*** Ridgway (Montana Junco) One specimen in the Ohio State Museum, No 7735, a male from Columbus 11/26/45, is labelled by Miller ' ***J h cismontanus*** x ***J o montanus***

*307 Eastern Tree Sparrow, ***Spizella arborea arborea*** (Wilson)

*308 Eastern Chipping Sparrow, ***Spizella passerina passerina*** (Bechstein)

309 Clay colored Sparrow, ***Spizella pallida*** (Swainson) One Ohio record, South Bass Island 5/12/40 (Walker 1941a) (OSM)

*310 Eastern Field Sparrow ***Spizella pusilla pusilla*** (Wilson)

*311 Harris s Sparrow, ***Zonotrichia querula*** (Nuttall) Casual

*312 White crowned Sparrow ***Zonotrichia leucophrys leucophrys*** (Forster) There are a number of scattered Ohio records of Gambel s Sparrow ***Z l gambelii*** (Nuttall) (Trautman 1935c (OSM), Stewart 1933 Walker 1940 Campbell 1940 and Kemsies 1948)

*313 White throated Sparrow ***Zonotrichia albicollis*** (Gmelin)

*314 Eastern Fox Sparrow ***Passerella iliaca iliaca*** (Merrem)

*315 Lincoln s Sparrow, ***Melospiza lincolnii lincolnii*** (Audubon)

*316 Eastern Swamp Sparrow, ***Melospiza georgiana georgiana*** (Latham)

*317 Mississippi Song Sparrow ***Melospiza melodia euphonia*** Wetmore

*318 Lapland Longspur ***Calcarius lapponicus lapponicus*** (Linnaeus) There is one Ohio record of the Alaska Longspur ***C l alascensis*** Ridgway Columbus 2/19/75 (Wetmore 1943c) (USNM)

319 Smith s Longspur ***Calcarius pictus*** (Swainson) Recorded from Oxford 4/9-30/49 (Mayfield 1949) (OSM) and Ashtabula Co (Hicks 1935b)

*320 Snow Bunting ***Plectrophenax nivalis nivalis*** (Linnaeus)

II Hypothetical List

In addition to the species listed above, the following species have been recorded from Ohio These species are either based on old records of specimens that cannot now be located or on sight records

1 Wilson s Petrel ***Oceanites oceanicus oceanicus*** (Kuhl) One record Auglaize Co 7/7/07 (Henninger 1907)

2 Man-o war-bird ***Fregata magnificens rothschildi*** Mathews One record Fairfield Co spring of 1880 (Davie 1898)

3 Great White Heron, ***Ardea occidentalis occidentalis*** Audubon A bird of this species was seen on the Ohio side of Lake Pymatuning in May, 1938, and was collected on the Pennsylvania side of the lake near Linesville on May 14 1938 (Trimble 1940)

*4 Hutchins s Goose ***Branta canadensis hutchinsi*** (Richardson) A few records from northern Ohio (Wheaton 1882, Campbell 1940) and one record from central Ohio (Trautman 1940)

5 Barrow s Golden-eye ***Bucephala islandica*** (Gmelin) Several northern Ohio records (Hasbrouck 1944a)

6 Eastern Harlequin Duck ***Histrionicus histrionicus histrionicus*** (Linnaeus) One Ohio record, a bird seen near Dayton 2/13/49 (Mayfield 1949)

*7 American Eider, ***Somateria mollissima dresseri*** Sharpe One Ohio record, Buckeye Lake 11/11/95 (Davie 1898)

8 Prairie Falcon, ***Falco mexicanus*** Schlegel One Ohio record Oberlin 9/20/40 (Jones 1941)

9 Long-billed Curlew, ***Numenius americanus americanus*** Bechstein A few records from central Ohio (Walker 1928a Trautman 1940) and Cincinnati (Langdon 1879)

10 Black-necked Stilt, *Himantopus mexicanus* (Müller) Recorded from Cincinnati (Langdon 1879), Lake Erie (Jones 1903) and Cleveland (Walker 1941b)

11 Pomarine Jaeger, *Stercorarius pomarinus* (Temminck) Casual in northern Ohio (Wheaton 1882, Jones 1903, Hicks 1935b)

12 Northern Skua, *Catharacta skua skua* Brünnich One Ohio record, Lucas Co 9/13/39 (Campbell 1940)

*13 Iceland Gull *Larus leucopterus leucopterus* (Vieillot) Recorded from Lucas Co (Campbell 1940), Ashtabula (Skaggs 1937) Lorain (Jones 1903), Put in Bay and Lake St Marys (Mayfield 1949) and central Ohio (Trautman 1940 Walker 1941b)

*14 Little Gull *Larus minutus* Pallas Three Ohio records Lake Co 12/29/23 (Doolittle 1924c) Ashtabula Co 12/23/47 (Hicks, Aud Field Notes 2 75) and Delaware Co 3/22/49 (seen by Mrs F S Thomas and Mrs J M Hengst)

15 Gull billed Tern, *Gelochelidon nilotica aranea* (Wilson) Recorded from Cleveland (Wheaton 1882)

16 Roseate Tern *Sterna dougallii dougallii* Montagu Recorded from Cincinnati (Langdon 1879) Cleveland (Wheaton 1882), and Lake Co 7/31/19 (Doolittle 1920a)

17 American Hawk Owl *Surnia ulula caparoch* (Muller) One fairly definite Ohio record, Lorain Co (Jones 1903) and several other Ohio records which are somewhat indefinite (Wheaton 1882 Kirkpatrick 1859 Dawson 1903)

18 Western Burrowing Owl, *Speotyto cunicularia hypugaea* (Bonaparte) One Ohio record Paulding Co October 1944 (Price 1946b)

19 Great Gray Owl *Strix nebulosa nebulosa* Forster Several records mostly from northern Ohio in winter (Langdon 1879 Wheaton 1882, Jones 1903 Dawson 1903)

20 Richardson's Owl *Aegolius funereus richardsoni* (Bonaparte) Reported from Ohio by Coues (1874), but the record is doubtful (see Wheaton 1882 and Jones 1903)

21 Texas Woodpecker *Dendrocopos scalaris symblectus* (Oberholser) One Ohio record Winesburg (Holmes Co) (Baird 1934)

22 Arctic Three toed Woodpecker *Picoides arcticus* (Swainson) Several records from northern Ohio (Wheaton 1882, Jones 1903, Doolittle 1918, Hicks 1935b Campbell 1940)

*23 Scissor-tailed Flycatcher *Muscivora forficata* (Gmelin) Three Ohio records Marietta 5/20/94 (Davie 1898) Marysville May 1903 (Jones 1905), and Pickaway Co 7/1/34 (a bird seen by T R Lathrop)

24 Brown headed Nuthatch *Sitta pusilla pusilla* Latham Reported from northern Ohio by Wheaton (1882)

25 Townsend s Solitaire, *Myadestes townsendi* (Audubon) Several records from Lucas Co (Campbell 1940)

26 Bohemian Waxwing *Bombycilla garrulus pallidiceps* Reichenow Reported from Lucas Co (Campbell 1940), Ashtabula Co (Wharram 1921), Lake Co (Doolittle 1920b) Logan Co (Curl 1932), and Hamilton Co (Kemsies 1948)

27 Audubon s Warbler *Dendroica auduboni auduboni* (Townsend) Three records, from northern Ohio Cleveland 4/30/31 and 5/3/31 (Watterson 1931) and Lake Co 10/5/41 (Godfrey 1943a)

*28 Arctic Towhee *Pipilo maculatus arcticus* (Swainson) Reported seen along the Scioto River, Delaware Co 3/29/46 by Charles F Walker, Gene Rea and Nelson Thomson

III Extirpated Species

1 Cory s Least Bittern, *Ixobrychus neoxenus* (Cory) One Ohio record, Toledo 5/25/07 (Ruthven 1907) (UM) Some thirty specimens of this bird are known, collected between 1885 and 1915, and although the A O U considers it a color phase of *I exilis* many ornithologists believe it to be a good species that has disappeared

2 Trumpeter Swan, *Cygnus buccinator* Richardson Last Ohio record about 1900 (Henninger 1919, Trautman 1940)

3 Swallow tailed Kite, *Elanoides forficatus forficatus* (Linnaeus) Last Ohio specimen in 1898 (Thomas 1933), and a sight record in 1928 (Gordon 1928)

4 Eastern Turkey, *Meleagris gallopavo silvestris* Vieillot This species disappeared from

Ohio about 1900 it has recently been introduced and has apparently become established, on Rattlesnake Island, in Lake Erie

5 Whooping Crane, *Grus americana* (Linnaeus) Formerly a rare migrant, the last definite Ohio record 11/26/76 (Wheaton 1882)

6 Eskimo Curlew *Numenius borealis* (Forster) Disappeared from Ohio about 70 years ago a late record, 1878 (Langdon 1879)

7 Passenger Pigeon, *Ectopistes migratorius* (Linnaeus) The last Ohio specimen was collected 3/24/00 (OSM)

8 Louisiana Paroquet, *Conuropsis carolinensis ludovicianus* (Gmelin) Last Ohio record 10/9/84 (Jones 1903)

IV Exotics

*1 Mute Swan, *Cygnus olor* (Gmelin) Introduced and very local

2 Flamingo, *Phoenicopterus ruber* Linnaeus An individual said to have escaped from the Cincinnati Zoo was seen in the late summer of 1926 in the southwestern part of the state (Trautman 1935a)

†3 Black Swan, *Chenopis atrata* (Latham) Two were seen on East Harbor Ottawa Co during late October and early November of 1925 (Trautman 1935a)

4 Baikal Teal, *Anas formosum* Georgi A male of this species was seen on the Scioto River in Delaware Co during late March and early April of 1933 (Trautman 1935a)

5 Sharp-tailed Grouse *Pediaecetes phasianellus* (Linnaeus) The Northern Sharp tailed Grouse *P p phasianellus* and the Columbian Sharp-tailed Grouse *P p columbianus* (Ord), have been introduced into Lucas Co (Campbell 1940) and elsewhere in the state

6 Band tailed Pigeon, *Columba fasciata fasciata* (Say) At least two have been seen in the vicinity of Columbus in the last fifty years (Trautman 1935a)

7 American Magpie *Pica pica hudsonia* (Sabine) One Ohio record Lucas Co 5/9 37 (Campbell 1937b) (OSM), probably an escaped cage bird

†8 Troupial *Icterus icterus* (Linnaeus) One Ohio record Columbus 12/1/32 (Hicks 1933)

9 Eastern Painted Bunting *Passerina ciris ciris* (Linnaeus) One Ohio record a bird seen at Sandusky (Dawson 1903)

The above is admittedly a very incomplete list of exotic species that have been seen in Ohio Many observers have reported escaped cage birds such as canaries parrots, penguins, and even an ostrich

V Hybrids and Others

The following hybrids have been reported from Ohio

1 Snow Goose x Blue Goose

2 Mallard x Black Duck

3 Mallard x Pintail

*†4 Brewster's Warbler *Vermivora leucobronchialis* (Brewster) A hybrid of the blue winged and golden winged warblers

*†5 Lawrence s Warbler, *Vermivora lawrencei* (Herrick) A rare hybrid of the blue winged and golden winged warblers

†6 Cincinnati Warbler *Vermivora cincinnatiensis* (Langdon) A hybrid of the blue winged and Kentucky warblers One Ohio record Hamilton Co 5/1/80 (Langdon 1880)

Skeletal remains of the following species have been excavated from Indian mounds in Ohio

1 Mississippi Kite *Ictinia mississippiensis* (Wilson) Remains found in Jackson Co (Wetmore 1932)

2 Little Brown Crane, *Grus canadensis canadensis* (Linnaeus) Remains found in Scioto Co (Wetmore 1943b)

3 Ivory billed Woodpecker *Campephilus principalis* (Linnaeus) Remains found in Scioto Co (Wetmore 1943a)

In the last 80 years at least two dozen species of birds have been introduced into Ohio but failed to become established Between 1872 and 1874 the Acclimation Society of Cincinnati spent about nine thousand dollars to introduce some twenty species of European birds (mostly passerines) in the vicinity of Cincinnati (Jour Cinc Soc Nat Hist, 4 342–343, 1881) In more recent years the state conservation department has attempted to introduce a few species of gallinaceous birds (Chapman, 1935, pp 656–663) Since these species died out soon after their introduction, it seems unnecessary to list them here

Migration Dates for the Birds of Central Ohio

The data presented in the following table are based on the migration records of the Wheaton Club (from 1922 through 1949) and on the records in the literature The area "central Ohio" includes roughly the territory within about forty miles of Columbus This tabulation is a revision of a similar tabulation by the writer in 1941 (Borror, 1941)

In the column indicating the *residential status* of each species ("RES"), the following symbols are used

PR—a nonmigratory permanent resident occurring in central Ohio throughout the year

PRM—a migratory species some individuals of which are to be found in central Ohio throughout the year such species are more common during the spring and fall migrations

M—a migrant or transient occurring in central Ohio during the spring and fall migrations migrants that are starred (**M***) are known to breed elsewhere in Ohio

SR—a summer resident breeding in central Ohio such species are more common during the spring and fall migrations

SV—a summer visitor not breeding in central Ohio but occasionally occurring here in the summer, species that are starred (**SV***) are known to breed elsewhere in Ohio

WR—a winter resident or visitor such species are more common during the spring and fall migrations winter residents that are starred (**WR***) are known to breed in northern Ohio

In the column indicating the *numerical status* of each species ("NUM"), the following symbols are used

VC—very common or abundant to be seen regularly and in some numbers

C—common to be seen regularly though not always in large numbers

FC—fairly common to be seen fairly regularly in varying numbers

U—uncommon to be seen not more than a few times each season and not at all in some seasons These species were recorded in at least sixteen of the twenty seven seasons on which the table is based

R rare to be seen only some seasons these species were recorded in from ten to fifteen of the twenty seven seasons on which the table is based

VR—very rare to be seen only in occasional seasons these species were recorded in from four to nine of the twenty seven seasons on which the table is based

A- accidental or casual species for which there are only a few records, or which were recorded in not more than three of the twenty seven seasons on which the table is based

When a species is more common at one residential status than at another, this condition is indicated by two or more lines of symbols in the two 'STATUS" columns For example, the common loon is a fairly common migrant, a very rare winter resident and an accidental summer visitor, the horned grebe is a fairly common migrant and a rare winter resident When a migrant species is more common at one season of migration than at another, this condition is indicated by two lines of symbols in the "NUM" column (with M in the "RES" column) For example, the lesser snow goose is accidental in the spring and rare in the fall When there is a variation in the status of a species in different parts of the central Ohio area, this condition is indicated in a footnote

When there are two lines of dates given for a species, those in the upper line are spring dates and those in the lower line are fall dates In the case of accidental species, and very rare species that have been recorded in only four or five seasons, the average dates are omitted

The earliest date of arrival in the spring and the latest date of departure in the fall are omitted in cases where the species is less common in winter than in spring or fall; when the species is accidental in winter, the extreme spring and fall dates are given in parentheses and represent the extremes for the seasons in which the species did not occur in central Ohio in the winter. Similarly, the latest date of departure in the spring and the earliest date of arrival in the fall are omitted in cases where the species is less common in summer than in spring or fall; these extremes are given in parentheses when the species is accidental in summer. All extreme dates are from the Wheaton Club records unless otherwise indicated.

For the most part, only species are listed in the following table. In cases where two or more subspecies of a given species occur in central Ohio and they are not listed separately in the table, the status of the different subspecies in this area is given in a footnote.

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Common Loon	M	FC		3-30	5-12	(6-11-31)
	WR	VR	(9-19-26)	10-19	11-25	
	SV	A				
Red-throated Loon	M	A	10-17-25			12-12-23[1]
Holboell's Grebe	M	VR	1-21-45[2]			5-20-26
	WR		10-25-25[2]			11-27-25
Horned Grebe	M	FC		3-21	4-27	5-12-23
	WR	R	9-7-24	10-13	11-22	
Pied-billed Grebe	M	C		3-15	5-7	
	WR	R		10-5	12-1	
	SR	R				
White Pelican	M	A	4-23-44			5-15-02[3]
			9-15-92[4]			10-25-74[1]
Double-crested Cormorant	M	U	4-1-78[5]	4-12	5-12	6-13-31
			8-25-30	9-28	10-31	12-15-27
Great Blue Heron	SR	C		3-14	11-25	
	WR	VR				
American Egret	M[6]	A	4-28-39			5-29-49
		U	6-19-32[3]	7-29	9-17	10-25-38[6]
Snowy Egret	SV	A	8-19-33			8-27-30[3]
Little Blue Heron	M	A	5-3-42			5-5-40
		VR	7-8-48	7-24	9-8	9-23-30[7]
Green Heron	SR	C	3-30-23[8]	4-16	10-7	11-16-26[8]

NOTE—See page 29 for explanation of reference figures.

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

Species	Status		Arrival		Departure	
	Res	Num	Earliest	Average	Average	Latest
Black crowned Night Heron	SR WR	FC VR		4- 3	10-10	
Yellow crowned Night Heron	M*	A	5- 4-46			5-22-46
American Bittern	M SR WR	FC VR VR		4 10 9- 2	5-20 10-24	
Least Bittern	SR	FC	5- 1-30	5- 9	9-12	9-20-28
Mute Swan	PR	U[9]				
Whistling Swan	M	VR	1-23-43 10 20 30			4-24-38 11-24-28
Canada Goose[10]	M WR SR[11]	FC U VR		3- 7 10 21	4-21 11-22	
American Brant	M	A	5-30-02[5] 11- 6 49			5-30-02[5] 11-10-49
White fronted Goose	M	A[12]				
Lesser Snow Goose	M	A R	1 21 25 10-18-23[8]	10 27	11-18	3 19 74[18] 12-28-29[3]
Blue Goose	M WR	R A	(3-4-49) 10-17-48	3-18 10-25	4-10 11- 7	4-18-27 (11-20-49)
Mallard	PRM	VC				
Black Duck	PRM	VC				
Gadwall	M WR	U R	9-10 30	3- 7 10-27	4 24 11 22	5 19-25
Pintail	M* WR	C R	9- 9-30[3]	2-20 9-30	4-23 11-29	5-22-49
European Teal	M	A	3- 6-32[8]			3- 6-32[8]
Green winged Teal	M* WR	FC R	8 26-22	3- 1 10- 6	4-14 11-28	4-20-23[8]
Blue winged Teal	M SR WR	C R VR		3-21 9- 6	5-18 11- 6	

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Cinnamon Teal	M	A	4- 4-95[4]			4- 4-95[4]
European Widgeon[14]	M	R	(2-23-41)	3-20	4- 9	4-16-26[8]
	WR	A				
Baldpate	M*	C		3- 1	5- 3	5-30-49
	WR	R	9- 6-30[8]	10- 3	11-21	
Shoveller	M*	U		3-18	4-28	5-25-27
	WR	VR	9- 4-79[8]	10-13	11-19	
Wood Duck	SR	FC	(2-28-32)[8]	3-20	10-20	(11-18-29)
	WR	A				
Redhead	M	FC		2-28	4-18	6-17 41
	WR	R	9-27-42	10-23	11-29	
Ring-necked Duck	M	C		2-26	5- 7	6- 3-28
	WR	R	10- 9-31	10-25	11-24	
Canvasback	M	FC		2-25	4- 9	4-28-31
	WR	R	10- 4-48	10-29	12- 3	
Greater Scaup Duck	M	A	2- 4-33[8]			4-23-76[13]
			10-30-26			12- 1-27
Lesser Scaup Duck	M	VC		3- 4	5-18	(6-10-49)
	SR	A	(9-24-29)[8]	10-22	12- 6	
	WR	R				
American Golden-eye	WR	FC	11- 9-41	11-24	4-13	5-21-38
Buffle-head	M	U		3-10	4-21	5-18-29[8]
	WR	R	10-25-49	11- 6	12- 2	
Old-squaw	M	R		3-18	4-19	5-18-41
	WR	VR	11-22-28			
American Eider[18]	M	A	11-11-95[4]			11-11-95[4]
King Eider	M	A	11- 4-80[13]			12- 2-26[1]
White-winged Scoter	M	VR	2-28-25			4-28-40[16]
		R	10-17-30	10-26	11-10	12-22-24[8]
Surf Scoter	M	A	3-26-31			4-28-17[8]
		VR	10-24-25			11-13-28
American Scoter	M	VR	2-26-33[16]			4-23-29
			10-22-27			11-28-24[6]

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

Species	Status		Arrival		Departure	
	Res	Num	Earliest	Average	Average	Latest
Ruddy Duck	M	FC		3-19	4-29	5-26-25
	WR	R	9-16-28	10- 9	12- 3	
Hooded Merganser	M	FC		2-27	4-22	(5-25-26)
	SR	A	(10 5-24)	10-24	12- 4	
	WR	R				
American Merganser	WR	C	11- 1-41	11-21	4-10	4-30-33[8]
Red-breasted Merganser	M	FC		3-20	5-11	(6-16-28)
	SR	A	(10 20-29)	11- 4	12- 2	
	WR	VR				
Turkey Vulture	SR	C		2-26	11-19	
	WR	R				
Black Vulture[17]	SR	FC		3- 5	10-30	
	WR	R				
Goshawk[18]	WR	A	11-29-24			3-31 23
Sharp-shinned Hawk	M	U		2-26	4-23	
	SR	R		8-30	10- 1	
	WR	R				
Cooper's Hawk	PRM	FC				
Red-tailed Hawk	PRM	FC				
Red-shouldered Hawk	PRM	U				
Broad-winged Hawk	M*	U	3-20-27	4-16	5-10	5-29-31
	SR	R	8-12-40	8-31	10-11	10-28-26
Rough-legged Hawk	WR	R	10-21-23	11-13	3-20	5- 3-42
Harris's Hawk	M	A	12-24-17[19]			12-24-17[19]
Golden Eagle	WR	A	12- 8-28			3-27-26
Bald Eagle	M*	U		2-23	4-11	5-18-42
	WR	R	7 18-42	9- 7	11-17	
Marsh Hawk	PRM	U				
Osprey	M	U	(3-28-25)	4- 7	5-10	(5-27-42)
	SV	A	(8-10-41)	9-13	10-19	(12- 4-48)
	WR	A				
Duck Hawk	M	R		2-12	4- 4	5-16-26[9]
	WR	VR	8-14-26	9-18	10-22	

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Pigeon Hawk	M* WR	R VR	 9- 5-29	2-25 9-20	4-30 11-24	5-20-33
Sparrow Hawk	PR	C				
Ruffed Grouse[17]	PR	U				
Hungarian Partridge	PR	VR				
Bob white	PR	C				
Ring-necked Pheasant	PR	C				
Sandhill Crane	M*	A	10- 9-26			10-24-48
King Rail	SR	FC	4- 7-29	4-29	9-10	10-12-26
Virginia Rail	SR WR	FC A	(3-27-27)	4-18	10-16	(11- 3-28)
Sora	SR	FC	3-25-28[3]	4-14	10-17	11-17-30
Yellow Rail	SR	VR	4- 9-27[8]			9-29-28
Black Rail	SR	A	4- 1-27			6-10-23[8]
Purple Gallinule	M	A	5-17 28			5-17-28
Florida Gallinule	SR	U	4- 1-27	4-25	10- 5	11-16-24
American Coot	M SR WR	VC R R		3-13 9-24	5-19 11-28	
Piping Plover	M*	VR	8-17-30[20]			9-20-29
Semipalmated Plover	M	U	4-22-28 7-20-42	5- 8 8-12	5-24 10- 3	5-29-31 10-30-24
Killdeer	SR WR	C R		2-19	11 23	
Golden Plover	M	R[21] U	3-24-29 8-15-23	4- 7 9-14	4-27 10-16	5-25-40[15] 12- 1-49
Black bellied Plover	M	VR R	5-12-76[13] 8-19-32	5-19 9-10	5-21 10-17	5-26-25[8] 11-14-30
Ruddy Turnstone	M	VR	5- 6-12[8] 9-14-25[8]			5-29-29[8] 10-27-40[22]
American Woodcock	SR WR	FC VR		3-17	10-28	
Wilson s Snipe	M* WR	C VR	 7-21-28	3-22 8-20	5-13 11-17	6- 7-48

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Long-billed Curlew[18]	M	A	5-22-26			5-31-02[9]
Hudsonian Curlew	M	VR	5-21-33			6-11-38[21]
Upland Plover	SR	FC	3- 4-42	4- 2	9-15	10-11-32
Spotted Sandpiper	SR	C	3-30-49	4-17	10-10	11- 7-23
Solitary Sandpiper●	M	FC	4- 1-48	4-19	5-22	(6-19-30)
	SV	A	(7- 3-25)	7-19	10- 1	11- 5-30
Willet	M	A	5-12-46			5-12-46
			7-26-42[24]			9-18-24
Greater Yellowlegs	M	U	2-21-25	3-30	5-12	5-23-31
			7-12-24	8- 4	10-27	12-11-25
Lesser Yellowlegs	M	FC	3-20-28	4- 4	5-23	6- 9-29
			7- 8-48	7-30	10-16	11-29-23
American Knot	M	A	5-27-78[1]			5-27-78[1]
Pectoral Sandpiper	M	FC	3-18-30[5]	4- 1	5- 6	5-25-27
			7-15-42	8- 2	10-31	12- 1-49
White rumped Sandpiper	M	VR	5-12-26	5-16	5-27	6- 4-23[6]
			7-12-24[5]	8-22	9-15	10-28-22
Baird's Sandpiper	M	VR	5-18-29			5-23-25[6]
		R	8- 7-27	8-24	9-24	11- 9-77[13]
Least Sandpiper	M	FC	4-24-49	5- 5	5-26	6-13-42
			7-11-25	7-30	10- 2	10-28-27
Red backed Sandpiper	M	R	5-10-41	5-18	5-24	5-29-31
		U	9-24-29[3]	10- 2	11- 3	12-28-49
Eastern Dowitcher	M	VR	5- 2-25			5-24-26
		R	8-12-26	8-21	9-30	10-23-26[3]
Stilt Sandpiper	M	A	4-20-26			4-28-28[25]
		R	7-17-28[3]	8-10	9-21	10-14-48
Semipalmated Sandpiper	M	FC	4-22-28	5- 9	5-28	6-10-28
			7- 8-48	7-28	10- 5	10-31-29
Western Sandpiper	M	R	7-19-30	8- 2	9-16	10-11-48
Buff breasted Sandpiper	M	A	5- 6-23			5- 6-23
		VR	8-19-33			9-29-28

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Marbled Godwit	M	A	4-21-79[18]			4-25-48
			9-13-25[26]			10- 8-81[1]
Hudsonian Godwit	M	A	5-22-26			5-30-25
			8-30-27			11- 7-25
Ruff	M	A	4-28-78[1]			4-28-78[1]
			11-10-72[1]			11-10-72[1]
Sanderling	M	A	5-10-24			5-22-26
		R	8-19-32	9- 2	9-30	11- 7 25
Red Phalarope	M	A	9-20-27			11- 2-29
Wilson s Phalarope	M	A	5-10-34[3]			6- 9-74[1]
			9-17 38[22]			9-17-38[22]
Northern Phalarope	M	A	5-17-41			6-11-38
		VR	8-28-33			10-13-49
Parasitic Jaeger	M	A	9- 2-19[3]			10-16 20[3]
Long tailed Jaeger	M	A	9 5-28[1]			9- 5-28[1]
Iceland Gull	WR	A	12-26-37[8]			4-12 41[22]
Great Black backed Gull	WR	A	11-19-33			11-19-33
Herring Gull	M*	C		2-20	5-14	6-30-48
	WR	U	9- 4-42	10-18	11 28	
Ring billed Gull	M	FC		3- 3	5-10	5-27-37
	WR	U	9- 2-30	10-11	11-28	
Franklin's Gull	M	A	10-10-37			10-15-06[17]
Bonaparte's Gull	M	U		4- 2	5- 6	
	SV	R		9- 2	11-14	
	WR	VR				
Little Gull	M	A	3-22-49			3-22-49
Atlantic Kittiwake	M	A	11- 7-25			11- 7-25
Sabine s Gull	M	A	10- 9-26			10- 9-26
Forster s Tern	M	A	4-19-25			4-19-25
		VR	8-17-32[1]			11- 2-27
Common Tern	M*	FC	4- 3-28	4-29	5-26	
	SV	R		8-24	10-11	11- 8-24

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Least Tern	M	A	5-28-24			5-28-24
Caspian Tern	M	R	4-11-43	4-29	5-17	
	SV	VR		8-29	9-23	10-18-23[8]
Black Tern	M*	FC	4-20-29	5- 3	5-21	
	SV	R		8-18	9-16	9-26-48
Domestic Pigeon	PR	VC				
Mourning Dove	PRM	VC				
Yellow billed Cuckoo	SR	FC	4-29-23	5- 6	10- 2	11-11-31
Black billed Cuckoo	SR	U	5- 1-40	5- 8	9-30	10-15-25
Barn Owl	PR	FC				
Screech Owl	PR	U				
Great Horned Owl	PR	VR				
Snowy Owl	WR	VR	11-20-10[28]			1-18-27[29]
Barred Owl	PR	FC				
Long eared Owl	M*	R		2-22	3-31	4-15-44
	WR	VR	9- 5-22			
Short-eared Owl	M	R		2-23	5- 4	
	SR	VR		10- 6	11-14	
	WR	R				
Saw whet Owl	PR	VR				
Whip-poor-will	SR	FC	4- 6-29	4-23	9-23	10- 6-27
Nighthawk	SR	C	4- 6-23	4-29	10- 1	10-19-24
Chimney Swift	SR	VC	4- 6-47	4-15	10- 8	11- 2-49
Ruby throated Hummingbird	SR	FC	4-19-23	5- 3	9-22	10- 7-31
Belted Kingfisher	PRM	C				
Northern Flicker	PRM	VC				
Pileated Woodpecker	PR	U				
Red bellied Woodpecker	PR	U				
Red headed Woodpecker	SR	FC		4-21	9-27	
	WR	R				
Yellow bellied Sapsucker	M*	C		3-25	5- 6	5-18-28
	WR	VR	9-13-25[8]	9-23	10-24	

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

Species	Status		Arrival		Departure	
	Res	Num	Earliest	Average	Average	Latest
Hairy Woodpecker	PR	FC				
Northern Downy Woodpecker	PR	C				
Red cockaded Woodpecker	M	A	3-15-72[1]			3-15-72[1]
Eastern Kingbird	SR	C	4-23-22	4-30	9-18	9-26-30
Arkansas Kingbird	M*	A	8-25-49			9- 9-48
Scissor tailed Flycatcher	SV	A	7- 1-34			7- 1-34
Crested Flycatcher	SR	C	4-21-22	4-28	9-25	11-16-31[1]
Phoebe	SR WR	C A	(2-23-30)	3-16	10-21	(11-20-49)
Yellow bellied Flycatcher	M	U	5- 2-26 8-11-31[3]	5-11 8-27	5-23 9-24	6- 4-40 10- 6-29[3]
Acadian Flycatcher	SR	C	4-20-30	5- 6	9-19	10- 7-28
Alder Flycatcher	SR	FC	4-24-48	5- 7	9- 7	10-23-49
Least Flycatcher	M*	C	4-22-48 8-12-40	5- 1 8-31	5-23 9-26	6- 1-27 10- 7-28
Wood Pewee	SR	C	4-23-29	5- 5	9-26	10-19-25
Olive sided Flycatcher	M*	U R	5- 3-28 8-10-24	5-14 8-30	5-27 9-22	6- 9-28[3] 9-28-25
Hoyt s Horned Lark	WR	A	11-26-80[10]			3-17-28[3]
Northern Horned Lark	WR	U	10-11-28	11- 9	3- 6	4- 7-29
Prairie Horned Lark	PRM	C				
Tree Swallow	SR	FC	3-18-44	4- 3	10- 5	11- 3-25
Bank Swallow	M SR	FC R	4-11-26	4-19 7-22	5-25 9- 9	 10-11-22
Rough winged Swallow	SR	C	4- 5-46	4-12	8-31	10-15-22
Barn Swallow	SR	VC	4- 2-32	4- 9	10- 6	10-29-31
Cliff Swallow	M SR	U R	4-15-33	5- 2 8-19	5-19 8-30	 10-10-25
Purple Martin	SR	VC	3-15-30	3-29	9-21	10-27-28[3]
Blue Jay	PRM	VC				
Crow	PRM	VC				
Appalachian Black-capped Chickadee	WR*	A	12- 6-81[19]			12- 6-81[19]

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Carolina Chickadee	PR	FC				
Tufted Titmouse	PR	C				
White breasted Nuthatch	PR	FC				
Red breasted Nuthatch	M*	U		5- 6	5-13	5-26-26
	WR	R	9- 5-28	9-10	11- 7	
Brown Creeper	WR*	FC	9-13-22[a]	10 1	5- 4	5-17-33
House Wren	SR	VC	(3-27-26)[a]	4-14	10- 8	(10-27-28)
	WR	A				
Winter Wren	WR	U	9- 8-31	9-27	5- 3	5-18-43
Bewick s Wren	SR	U		4- 2	9- 28	
	WR	VR				
Carolina Wren	PR	FC				
Prairie Marsh Wren	SR	FC		4-26	10-25	
	WR	R				
Short billed Marsh Wren	M	R	(4-29-31)	5- 7	5-19	
	SR	VR		9-28	10-15	(10 21-28)
	WR	A				
Mockingbird	PR	U				
Catbird	SR	VC	(4-13-31)	4-22	10 22	(11-17-28)[a]
	WR	A				
Brown Thrasher	SR	C	(3-21-26)	4- 3	10-12	(11- 2-29)[a]
	WR	A				
Robin	SR	VC		2- 18	11-21	
	WR	U				
Wood Thrush	SR	C	(3-26-30)	4-20	9-26	(10-14-29)
	WR	A				
Hermit Thrush	M*	C		3-29	5- 9	5-18-31
	WR	R	9- 9-32	9-28	11- 3	
Olive backed Thrush	M	C	4- 6-23 8-23-29	4-24 9- 5	5-28 10-13	6- 8-28 11- 3-28
Gray-cheeked Thrush	M	FC	4-20-29 9- 1-25	5- 3 9-14	5-24 10- 4	6- 2-28 10-28-26[a]

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Veery	M*	U	4-15-29 8-17-25	5- 2 8-31	5-22 9-30	5-31-28 10-18-31
Bluebird	SR WR	C U		2-23	11-15	
Blue gray Gnatcatcher	SR	FC	3-31-24	4-13	9-11	10- 3-29
Golden-crowned Kinglet	WR	C	9-25-28	10- 1	5- 1	5-18-32
Ruby-crowned Kinglet	M WR	C R	 8-22-31	4- 2 9-21	5-17 10-28	5-31-25
American Pipit	M WR	U VR	 9- 5-25	3-21 9-24	5- 7 11- 7	5-27-48
Cedar Waxwing	PRM	FC				
Northern Shrike[18]	WR	A	11- 8-24			4- 5-31
Migrant Shrike	SR WR	U R		3-16	9-16	
Starling	PRM	VC				
White-eyed Vireo	SR	FC	4- 9-22	4-25	9-21	10- 6-28
Yellow throated Vireo	SR	FC	4-14-41	4-28	9-19	10- 2-31
Blue headed Vireo	M*	FC	4-19-25 9-12-27	4-26 9-22	5-17 10-13	5-27-28 10-21-44
Red eyed Vireo	SR	VC	4-22-23	4-30	10- 2	10-14-24
Philadelphia Vireo	M	U	5- 2-26 8-30-31	5- 8 9-13	5-23 10- 4	6- 4-28 10-14-49
Warbling Vireo	SR	C	4-13-49	4-26	9-20	10- 7-28
Black and White Warbler	M SR	C U	4- 5-47 	4-21 8-11	5-18 9-29	 10-13-48
Prothonotary Warbler	SR	U	4- 6-47	4-30	9-13	10- 5-24
Worm-eating Warbler[21]	SR	FC	4-18-22	4-30	9- 4	9-17-29
Golden winged Warbler	M*	U VR	5- 1-41 8- 4-28[3]	5- 7 	5-14 	5-19-25 9- 6-30
Blue-winged Warbler	SR	U	4-20-29	4-29	9-16	10-15-30
Brewster's Warbler	SR	VR	5- 6-28			9-15-29
Lawrence's Warbler	M	A	5-13-30			5-13-30

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Tennessee Warbler	M	C	4-27-48	5- 6	5-25	6- 2-26
			8-24-31	8-30	10-11	10-31-25
Orange crowned Warbler	M	U	(4-25-25)	5- 3	5-13	5-18-41
	WR	A	9-16-38[33]	9-23	10-11	(10-20-26)[8]
Nashville Warbler	M*	C	4-23-25	4-28	5-20	5-30-23
			8-16-29	9- 2	10- 8	10-23-27
Parula Warbler[31]	M	FC	4-15-40[15]	5- 2	5-23	
	SR	U		8-25	9-24	10- 9-27
Yellow Warbler	SR	VC	4-11-32	4 22	9-15	9-29-28
Magnolia Warbler	M*	C	4-15-48	5- 3	5-27	6- 6-30
			8-11-31	8-25	10- 8	10-19-41
Cape May Warbler	M	FC	(4-29-33)[8]	5- 5	5-20	5-29-49
	WR	A	8-12-40	9- 1	10- 2	(10-16-27)
Black throated Blue Warbler	M*	U	4-29-32	5- 6	5-20	5-28-24
			8 28-24	9- 6	10- 6	11-11 44[1]
Myrtle Warbler	M	VC		4 11	5-21	5-27-24
	WR	R	8 18-44	9-17	10-31	
Black throated Green Warbler	M	C	4-14-41	4-22	5-24	
	SR	R		8-31	10-12	10-31-25
Cerulean Warbler	SR	FC	4-22-23	4-30	9- 9	9-26-49
Blackburnian Warbler	M*	FC	4-20-27	5- 1	5-24	6- 1-24
			8-13-25	8-29	10- 5	10-14-28
Sycamore Warbler[32]	SR	VR	4- 7-77[18]	4-30	8-24	10- 8-81[1]
Chestnut-sided Warbler	M*	C	4-27-48	5- 4	5-24	6- 4-28
			8-12-24	8-29	9-28	10- 7 23
Bay breasted Warbler	M	C	4-26-25	5- 6	5-25	6- 3-28
			8-18-25	9- 1	10-14	10-30-48
Black poll Warbler	M	U	4-16-75[1]	5- 8	5-26	6- 6-24
		C	8-28-42	9- 8	10-16	11- 1-25
Pine Warbler	M	U	(3-20-24)[8]	4-18	5- 5	
	SR	VR		9-16	10- 7	(10-21-26)
	WR	A				

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Kirtland's Warbler	M	VR	5-13-27	5-18	5-25	5-29-49
			9-11-25[24]			9-11-25[24]
Prairie Warbler[21]	SR	FC	4-16-38[33]	4-30	9- 5	10- 6-27
Palm Warbler	M	FC	(4-17-31)	4-24	5-16	5-22-46
	WR	A	8- 9-33[3]	9-10	10-16	(12-13-24)[6]
Ovenbird	SR	C	4-16-22	4-26	10- 2	10-16-49
Water Thrush[22]	M*	FC	4-15-77[13]	4 28	5 19	5-29-25
			8- 9-26	8-23	10- 2	10-16-30
Louisiana Water Thrush	SR	FC	3- 7-46	4 7	9-18	10-11-31
Kentucky Warbler[21]	SR	FC	4-17-27	5- 4	9-13	9-29-28
Connecticut Warbler	M	FC	5- 3-44	5-12	5-28	6- 7-24
			8-27-31	9- 8	10- 2	10-12-98[1]
Mourning Warbler	M*	FC	5- 1-24	5 12	5-28	6- 2-28
			8-23-24	9- 5	9-30	11- 1-25
Northern Yellowthroat	SR	C	(4-17-22)	4-25	10- 9	(11- 2-29)
	WR	A				
Yellow-breasted Chat	SR	C	4-25-31	5- 2	8-27	9-22-48
Hooded Warbler[21]	SR	FC	4-19-25	5- 2	9-20	10-10-31
Wilson's Warbler	M	FC	5- 2-36	5-11	5-26	6- 2-28[3]
			8-20-25	8-27	9-24	9-30-42
Canada Warbler	M*	C	5- 2-37	5- 7	5-27	6- 7-42[24]
			8-12-37[24]	8-27	9-21	10- 2-42
American Redstart	M	C	4-25-31	5- 3	5-23	
	SR	R		8-22	10- 6	10-27-27
English Sparrow	PR	VC				
Bobolink	SR	FC	4-12-03[5]	4-27	9-29	10-27-28[3]
Eastern Meadowlark	SR	VC		2-28	11-27	
	WR	R				
Western Meadowlark	M*	A	5- 5-46			5-26-46
Yellow-headed Blackbird	M*	A[23]	2-26-25			3- 8-31
Eastern Redwing	SR	VC		3- 3	11-22	
	WR	R				

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Giant Redwing	WR	A	10-28-27[1]			1- 2-33[1]
Orchard Oriole	SR	FC	4- 3-29	5- 3	8-19	8-28-25
Baltimore Oriole	SR	C	4- 4-29	4-29	9-16	10-11-28
Rusty Blackbird	M	FC		3-11	4-28	5-31-41[1]
	WR	R	9- 9-73[13]	10- 2	11-16	
Bronzed Grackle	SR WR	VC R		2-27	11-18	
Cowbird	SR WR	VC R		3- 5	11-20	
Scarlet Tanager	SR	FC	4-17-27	4-30	9-23	10-11-29
Summer Tanager	SR	FC	4-22-23	5 3	9-22	10- 7-31
Cardinal	PR	VC				
Rose breasted Grosbeak	M*	FC	4-24-29	5- 3	5-20	6- 3-74[13]
			7-26-22	8-29	10- 2	10-21-44
Indigo Bunting	SR WR	VC A	(4-24-25)	5 1	10- 1	(10-16-80)[1]
Dickcissel	SR	R	4 28-25	5 7	8 28	9-27-30[3]
Evening Grosbeak	WR	A	12-10-89[4]			4-30-46
Purple Finch	M*	U		4- 4	5-12	5-24-24
	WR	R	9 18 24	9-29	11- 5	
Common Redpoll	WR	A	12-22-35[3]			2-17-23
Pine Siskin	M	R		4-30	5-18	5-29-24
	WR	VR	10-12-48	10-26	11-18	
Goldfinch	SR WR	VC FC		4-11	11-15	
Red Crossbill	WR	A	10 11 03[5]			6-18-78[1]
White winged Crossbill	WR	A	12- 4-25[20]			2-28-26
Red-eyed Towhee	SR WR	C R		3- 5	10-29	
Arctic Towhee	M	A	3-29-46			3-29-46
Savannah Sparrow	M SR WR	U VR A	(3-10-25)	3-26 9-17	5- 4 10-27	(11-13-42)

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Grasshopper Sparrow	SR WR	C A	(3-26-39)	4-17	9 15	(10-13-30)
Leconte s Sparrow	M	A	10-31-36[37]			11-23-36[37]
Henslow s Sparrow	SR WR	FC A	(4- 6-29)	4-21	9-15	(10-25-29)
Nelson s Sparrow	M	A	4-18-25 9-19-29			5-27-28 10- 8-27
Vesper Sparrow	SR WR	C VR		4-25	10-27	
Lark Sparrow	SR	R	4-24-27	5-14	8-30	9-28-74[13]
Bachman s Sparrow	SR	U	4-10-25	4-24	8-27	9-17 31
Slate-colored Junco	WR*	VC	9-15-28	9-26	5- 5	5-30-25[8]
Intermediate Junco	WR	A	11-26-45[1]			4- 4-46[1]
Oregon Junco	WR	A	11-20-49			1 2-46[1]
Tree Sparrow	WR	VC	9-27-31	10-21	4-20	5- 7-33[3]
Chipping Sparrow	SR WR	C A	(3-17-28)	3-30	10-20	(11-16-32)
Field Sparrow	SR WR	VC A	(2-27-49)	3-17	10-30	(12- 4-31)
Harris s Sparrow	M	A	4- 1-23 10-20-28			5-14-25 11-12-21[26]
White crowned Sparrow	M WR	FC VR	 9-27-30	4-29 10- 6	5-19 10-28	5-29-49
Gambel s Sparrow	M	A	5-13-43 10-13-28[1]			5-13-43 10-13-28[1]
White throated Sparrow	M* WR	VC R	 9-12-27	4- 1 9-24	5-22 11-13	6-11-48
Fox Sparrow	M WR	FC VR	 9-21-44	3-14 10-12	4-23 11-14	5-20-22
Lincoln's Sparrow	M	U	4-16-32 9- 4-31	5- 5 9-25	5-19 10-23	5-28-24 11- 3-29[3]

TABLE OF MIGRATION DATES FOR THE BIRDS OF CENTRAL OHIO—(*Continued*)

SPECIES	STATUS		ARRIVAL		DEPARTURE	
	Res	Num	Earliest	Average	Average	Latest
Swamp Sparrow	M SR WR	FC R R		4- 1 9-22	5-16 11- 3	
Song Sparrow	PRM	VC				
Lapland Longspur	WR	R	11- 3-26[2]	12- 7	2-20	4-12-30
Alaskan Longspur	WR	A	2-19-75[38]			2-19-75[38]
Snow Bunting	WR	R	10-30-26	11-23	2-21	3- 3-29

EXPLANATION OF REFERENCE FIGURES USED IN TABLES

[1] Skin in the Ohio State Museum
[2] Mayfield 1945
[3] Trautman 1940
[4] Davie 1898
[5] Dawson 1903
[6] Walker 1939
[7] Hicks 1931
[8] Walker 1928a

[9] There have been two or three birds along the Scioto River between Griggs Dam and Bellepoint, since 1944

[10] These dates refer to the Common Canada Goose there is one central Ohio record of Hutchins s Goose (Trautman 1940)

[11] A few individuals possibly from the Columbus Zoo have nested in the Depp Pond (Twin Lakes) area in recent years

[12] A skin in the Ohio State Museum no X W/1955, labelled 'Fairfield Co O ' without date

[13] Wheaton 1882

[14] Hasbrouck (1944b) discusses the status of this species in North America and gives 3-21 to 5-4 as the normal Ohio dates

[15] Walker 1940
[16] Hicks 1934b
[17] Sugar Grove region, accidental elsewhere in central Ohio
[18] There is some doubt of the validity of these records
[19] Earl 1918
[20] Hicks 1938a
[21] More common, especially in the spring, in the western part of the central Ohio area
[22] Walker 1941b
[23] Walker 1938
[24] Walker 1942
[25] Hicks 1929
[26] Thomas 1926
[27] Jones 1907
[28] Bales 1911
[29] Thomas 1928
[30] Oberholser 1919
[31] Summer resident in the Sugar Grove region, a migrant farther north in central Ohio
[32] More common in southern Ohio, accidental in Franklin Co

[33] Both the Northern Water Thrush and Grinnell's Water-Thrush occur in central Ohio the latter appears to be the more common subspecies

[34] Walker 1937

[35] Dawson (1903) reports a pair of this species seen near Groveport, in the summer of 1873, by Wheaton

[36] Anonymous 1928
[37] Hicks 1937b
[38] Wetmore 1943c
[39] Duvall 1945

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THE GEOGRAPHICAL BASIS OF NATIONAL POWER

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INTRODUCTION

Unfortunately there exists today widespread misunderstanding or even ignorance, not only of basic geographic factors which in large measure direct every major step taken in world politics, but also of the influence that natural environment plays in the survival of nations A broad knowledge of geography is essential in any attempt to gain an understanding, if only in part, of the numerous problems confronting people throughout the world (Fig 1) These problems, though usually of an economic, political, or cultural nature, generally have a definite geographical foundation From a thorough and critical geographic study one should be able to discover the basis as well as the essential characteristics of man's unceasing competitive struggle for existance and recognize that the means by which men and women of a given region secure their livelihood reflect adjustments to physical conditions

FIG 1 Geographic study is basic in analyzing domestic and world problems

In order to endure, a state must first of all provide complete protection against all enemies, both domestic and foreign, for each individual living within the bounds of its jurisdiction Secondly, it must afford freedom of opportunity whereby each citizen can gain a worthy means of livelihood In view of these two great responsibilities a nation should take every necessary precaution to assure its people of security from all anxiety, fear, or danger The inhabitants of the United States or of any other country cannot be free to enjoy an *abundant life*, which is rightfully theirs, if compelled to live under the economic, political, and cultural domination of another state And yet there are always national entities which attempt by various devices to gain permanent supremacy over others, even though it usually results in much unwarranted suffering and cultural destruction

A few far-seeing individuals dream of forging all nations into a voluntary democratic federation, the activities of which would be largely devoted to bettering the welfare of humanity with complete respect for the rights and privileges of each member of society However, such an Utopian ideal still seems far beyond the grasp of mankind and thus a world of realities must be faced, a world filled with uncontrolled human emotions and passions The people of the United States should become aware of their national insecurity and the dangers which confront them, they should be deeply impressed by the one great principle - as human beings each man, woman, and child is a vital, throbbing part of the world in which they live

The American people cannot afford to remain unaware of the intimate relationships existing between geography and human activities, for the United States holds a unique place in world affairs due primarily to the favorableness of its geographic position and environment This nation is the only major state with direct access to both the Atlantic and Pacific oceans which is capable of exerting tremendous political pressure because of its actual as well as potential power World leadership is open to the American people, they must be ready and willing however to grasp this commanding position Such an opportunity demands that each individual be well informed particularly in social sciences, so as to gain a richer comprehensiveness of the guiding principles of modern society The people of the United States will have to develop a *global concept* if they are to play a vital and successful role in world affairs, the earth must be viewed as a single integrated unit and a realistic approach taken to present problems

Mental laziness and utter disregard for personal responsibilities has led the people of this country, time after time, into a sense of false security as only too well revealed by the late war Such a situation cannot be continued if the nation is to avoid ultimate and complete destruction There is a great need for careful analysis of the intricate pattern of American domestic and foreign policies as well as thorough understanding of the urgency for resource mobilization in the interest of national security In order to safeguard its position as the arsenal of democratic principles, the United States must have actual as well as potential military strength, for power has no meaning unless backed by adequate armed support Mere recognition of defense requirements is not itself ample to safeguard the future The citizenry, through the degree of its interest and active participation in national security measures, will determine the safety of the country

EXPANSION AND NATIONAL POWER

A desire to explore unknown parts of the globe, and the hope on the part of many to find fabulous wealth in undiscovered lands, has caused men to travel into all parts of the world The quest for hidden wealth has been carried down through the ages and it may well be expected to continue as long as man inhabits the earth Phoenician traders secured tin from the mines of Cornwall, merchants of Genoa and Venice collected silks and spices in the Orient, Spanish conquistadores drew vast treasures of gold and silver from the mines of Middle and South America, and French voyageurs gathered cargoes of priceless furs from the streams and woodlands of what is now Anglo-America The search continues, and men go on struggling through fever- and mosquito-ridden swamps, across wind-swept arctic and saharan deserts, and over towering mountain ranges, always carrying in their hearts the burning desire to find resources that will bring power and wealth as well as ever-lasting fame. The United States ranks foremost among the nations in this search, seeking new and greater mineral possibilities, additional agricultural products, and valuable medicinal materials.

It is largely the geographic conditions, such as space relations (location, size and shape), land forms, climate, land content (soils and minerals), and native vegetation, which strengthen some states and weaken others. These several conditioning elements, coupled with population numbers and distribution (Fig. 2), have great influence on international problems and, consequently, do much in shaping the attitudes of people throughout the world toward peace and aggression. The direction a state expands is dependent upon both geographic and human factors, but as a general rule the stronger states move into adjacent territory which may be either sparsely populated or poorly governed. In many instances expansion is more or less incidental but often becomes part of a national ideal and heavy pressure develops for ***lebensraum*** as expressed by Germany and Japan on numerous occasions. Formerly the right to expand was chiefly a matter of which state, having adequate power to maintain itself, took control first. If the area was so situated as to command broad areas of land or water, or control strategic lines of communication and transportation, it greatly increased the power potential of the occupying nation. The acquisition of suitable land, sea, and air bases often creates many international problems because in time of war such bases may assume strategic importance. However, expansion carries with it certain elements of weakness

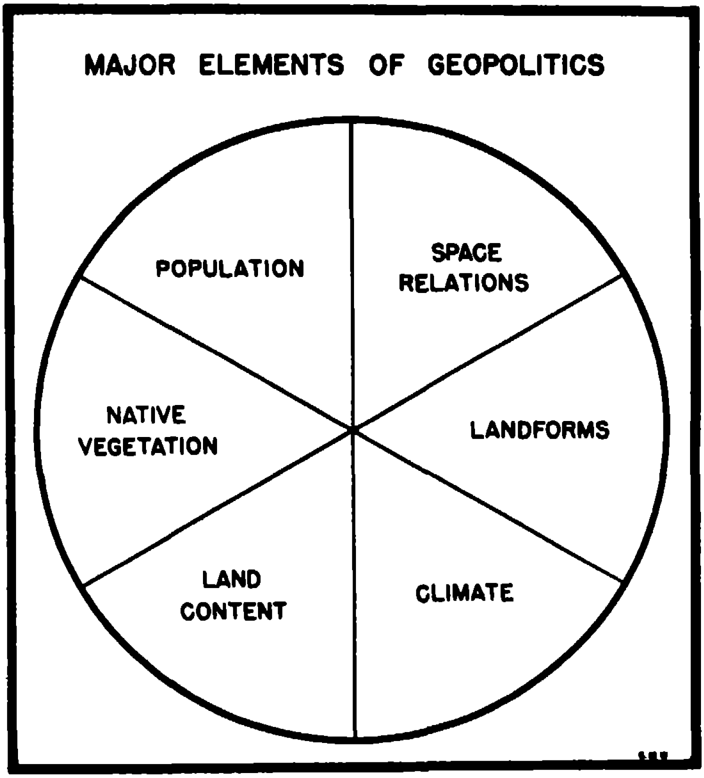
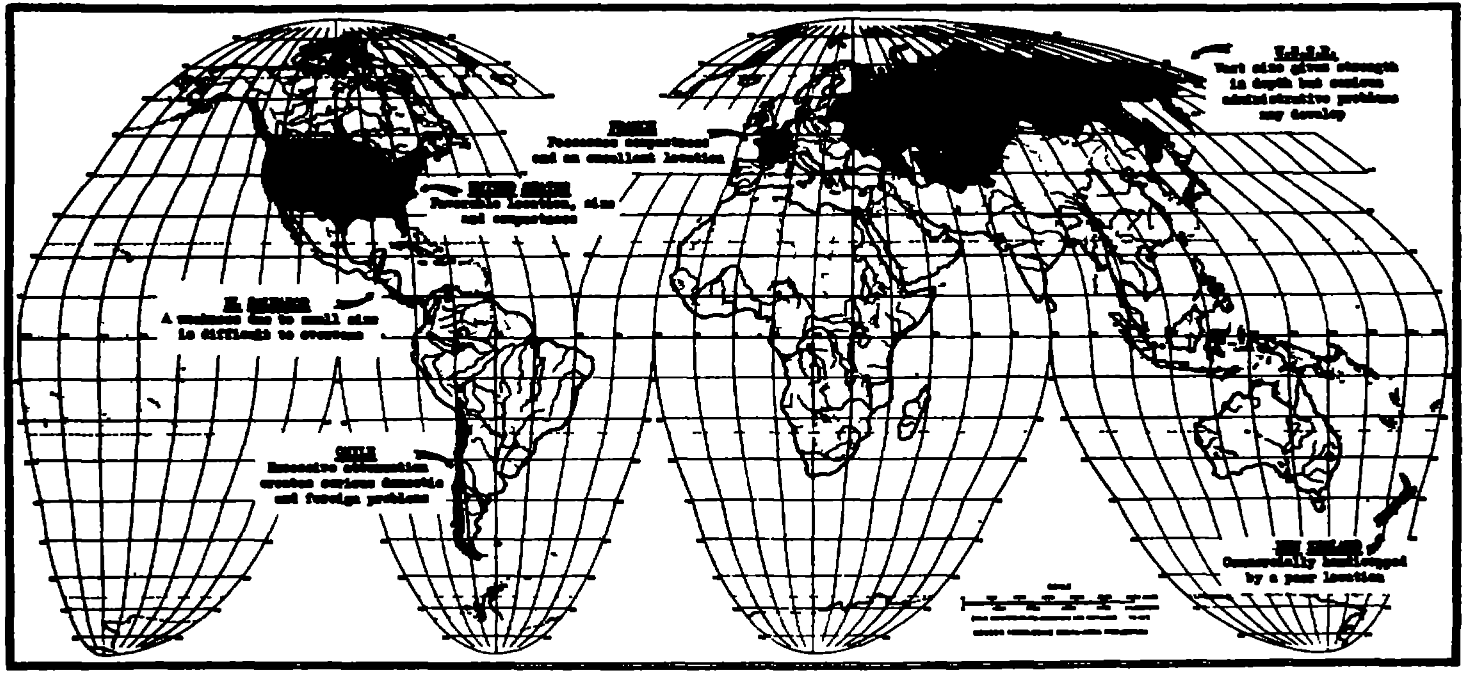


Fig. 2. The success or failure of a nation to become a world power is dependent primarily on the major elements of geopolitics.


U.S.S.R.
Vast size gives strength in depth but serious administrative problems may develop
FRANCE
Possesses compactness and an excellent location
UNITED STATES
Favorable location, size and compactness
EL SALVADOR
A weakness due to small size is difficult to overcome
CHILE
Excessive attenuation creates serious domestic and foreign problems
NEW ZEALAND
Commercially handicapped by a poor location
GOODE'S SERIES OF BASE MAPS

Based on Goode Base Map No 101HC. Copyright 1937 and 1938 by The University of Chicago Used by permission of The University of Chicago Press

Fig 3 Space relations largely determine the economical and political development of a state

inasmuch as the borders of a state may become increasingly longer and often not readily defensible in a geographic sense, the Great Wall of China was intended to correct the weakness incurred by an overexpanded state

A leading objective in colonization has been the hope of discovering minerals of definite economic value Although the economic value of colonies or dependencies may be seriously questioned, it should be recognized that they do possess four definite geopolitical values, namely (1) usually give political prestige to the holder (2) represent in many instances a source of manpower, especially for military considerations, (3) may offer strategic bases during economic or military conflicts, and (4) possibly furnish a suitable outlet for immigration from the holding power Island possessions such as the East Indies or Hawaiian group often become stepping stones to world power, at times serving as critical outposts

SPACE RELATIONS

(Fig 3)

Location—The position of places and resources on the earth's surface is of great importance to a state, for security as well as industrial development It is of paramount consideration in analyzing a nation's actual and power potential since both are mainly dependent on the total distance of that country from other force centers Many locations are considered *strategic* and in time of peace may seriously influence trade, while during conflict they may serve as important bases for military operations Location plays a major role in the mobilization of a nation's resources and largely determines their degree of accessibility a factor which no state can afford to ignore if expecting to survive in a world harassed by international conflict

Size—Since areal extent affects both the development of a state and its role in international affairs, the importance of space cannot be dismissed lightly Although a relatively large area is not in itself indicative of power, it may usually be regarded as a prerequisite and therefore the desire for more land often furnishes an incentive for a nation to engage in armed conflict Size measurably determines the vulnerability of industrial establishments and transportation-communication nets even though they may be fairly well decentralized, the security of population centers is likewise affected In many instances the land area of a country is such that it affords the people an opportunity to become large in numbers, in other situations it is much too inadequate for the needs of an expanding population as occurs in Haiti and Japan

Protection afforded by great depth adds much to defensibility regardless of whether the attack is made by air, land or sea, or a combination of all three In periods of international strife, a nation with good depth can carry through military operations on the perimeter while mobilization of manpower and protection of industry is made possible in the more central parts of the country The state with a densely populated core surrounded chiefly by sparsely occupied territory is in possession of a definite advantage over one not so constituted It needs to be recognized, however, that depth may become a liability to the defender when that nation takes the offensive, especially if the *scorched earth* strategy is applied by either side in retreating

Shape—The shape of a state also has direct bearing on its economic, political and cultural life as well as on the mechanics of warfare Throughout the history of nations there has always been the desire on the part of some to round out their territory, even at the expense of a peaceful neighbor Compactness makes for political unity and greatly facilitates transportation and communications, and the mobilization of industry, labor, and military forces in times of emergency However, if compactness is not combined with large size, the vulnerability of the state is considerable, especially to modern aerial attack In case of excessive elongation

(Chile offers an excellent example) the assailability of any one section of the country becomes a major problem This elongation may also cause serious internal weakness due to a natural tendency for inhabitants to develop strong sectionalism

Land Forms—The greatly varied land forms of most states considerably influence international relations and the execution of military operations The arrangement and distribution of mountains plateaus and valleys determine to an appreciable extent the condition of other natural factors which circumscribe in most instances man s activities Location of transportation and communication lines industrial and commercial centers and the distribution of population result mainly from varying topographic features The world s great cities and areas of dense rural population are found chiefly on low-lying productive plains or on the lower slopes and broad valleys in the somewhat rugged highlands Terrain may serve as a pronounced barrier to the flow of goods and to movements of people but in so doing it also restricts the possibilities of conflict (Fig 4) In many instances international boundaries have been rearranged in order to take advantage of certain physiographic conditions as in the case of the French Spanish border

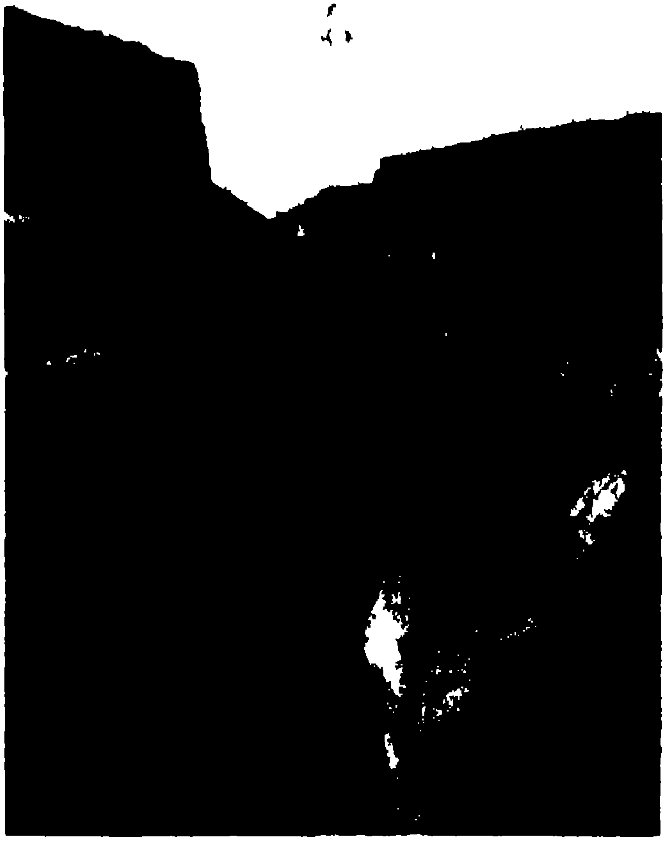


FIG 4 A stream bordered by steep cliffs while interfering with commerce tends to restrict boundary conflicts

A majority of states possess both land and sea boundaries which depending upon the country s topography may represent an asset or a distinct liability

Coastlines usually constitute an important item in national power so much so that landlocked states tend to seek direct access to the world s sea lanes If successful such action necessitates the building of a navy in order that a country may not only defend its coastline exposure but consider itself a sea power Insular states or those whose borders are peninsular or predominantly coastal can be expected to maintain a navy and air force as first lines of defense Configuration of a coast line largely determines a maritime state s vulnerability to naval attack if a modern nation possesses numerous good harbors the naval forces will no doubt be prominent On the other hand if the coast affords few suitable indentations for harbor development the air force may well be expected to occupy foremost position in the military establishment

CLIMATE

Climate occupies a leading place in the economic political and cultural relations between states since international problems often have their beginning in pronounced climatic differences To a large extent climate determines the health and energy of mankind having direct effect on the accuracy and speed with which people work Regions either extremely hot cold wet or arid are generally sparsely populated and fail to attain a high degree of civilization (Fig 5) The development of powerful states has usually taken place in the more humid parts of the earth possessing intermediate temperatures these regions occur mainly in the middle latitudes In time of conflict climate has often proved an outstanding ally of the defender as well as the invader Nearly all military operations are scheduled so that certain favorable weather conditions may be present particularly for offensive strategy at times an entire military campaign is decisively changed due to the unexpected advent of cold fog or rain

Fig 5 Semiarid regions offer little encouragement to settlement unless the land is fertile and suitable amounts of water are available for irrigation

The productivity of a state depends chiefly on climate, a factor which in turn largely determines the availability of water resources, the nature of soils, and the type and quantity of vegetable and animal products raised Some climates are characterized by only slight changes in temperature or precipitation from season to season while others experience marked variations during the year Fluctuations in temperature, and the amount and distribution of precipitation, have much influence on the habitability of any given region A state large in area, such as China the Soviet Union, or the United States, can greatly benefit from the fact that it includes within its boundaries a wide variety of climates, each one contributing to the diversity as well as to the balance of its productive capacity The success or failure of many economic and industrial enterprises is directly traceable to conditions of climate

LAND CONTENT

In order to become a world power, a state must either have essential natural resources within its borders or else the power to guarantee access to foreign supplies at all times The uneven distribution of the world's resources is largely responsible for a desire on the part of governments to own or control productive areas in various parts of the globe Coal, petroleum, iron, copper, tin, cotton, rubber, wool, meat, sugar, tobacco, and wheat are critical commodities in a bid for national power Of these, iron, copper, coal, petroleum, cotton, and rubber are basic raw materials for an industrial economy A state lacking sufficient quantity and variety of food, minerals, and other raw materials for satisfactory economic development, is dependent on foreign sources to supply its deficiencies In view of this situation many nations continually strive to devise means whereby the raw materials it lacks domestically can be secured elsewhere, a state often adopts a national policy calling for aggressive military action in case other measures fail in securing adequate resources It is poverty in raw materials which usually makes for international conflicts, sometimes gradually involving most countries of the world

The endeavor of a state to become self-sufficient is a natural outgrowth of the fear that results from numerous disquieting world conditions A country which attempts to practice such a policy in respect to its total economic needs however, can never find a prominent place among world powers because no single nation, not even the United States or the Soviet Union has a complete array of vital resources Self-containment on the part of any modern nation is impossible The effectiveness of national power is largely determined by a state's capacity for industrialization which, in turn, is almost wholly dependent upon the availability of essential raw materials The outcome of any international conflict depends mainly on whether one or the other of the warring countries can maintain an adequate supply of vital raw materials in case there is a severance of extraterritorial transportation and communication lines, thereby preventing the flow of outside materials However, it should be remembered that not only must a state possess adequate resources but its people need to have the faculty of utilizing them to the best advantage

The United States is perhaps the world's richest and most powerful nation The development of its economy has been largely governed by a wealth of readily available raw materials and the ability of the American people to utilize them effectively It is also considered to be one of the most self-sufficient countries and yet, in spite of a considerable array of domestic resources, approximately thirty per cent of the nation's basic raw material requirements, many of strategic importance, are secured from foreign areas These sources of supply, especially those of extracontinental origin, present a serious weakness in American defenses because of the vulnerability of supply lines, particularly to sustained aircraft and submarine attack The United States can not maintain itself in the face of powerful aggression unless it possesses suitable and readily available domestic raw materials or has absolute control of foreign sources of supply which can be safely transported even in periods of international conflict The success or failure of the nation to fully meet requirements for national security will depend chiefly upon its ability to secure and utilize adequate supplies of vital materials, regardless of world conditions

Soil —Soil is the basic land resource and should be regarded as the most valuable of all natural resources since it provides, in the form of vegetable and animal products, the subsistence of mankind The abundance or scarcity of food production, a serious factor in security as well as the foremost requirement for national power, largely determines the economic, political, and cultural development of a people Countless other basic necessities, including a broad variety of raw materials for industry, are produced from the soil In many regions throughout the world, agriculture is the predominant occupation because suitable climatic and soil conditions are present for satisfactory plant growth No state can adequately maintain a fairly dense population, on an agricultural base or otherwise, if it does not possess sufficient amounts of productive land and the means whereby the fertility of the land can at least be maintained (Fig 6) unless the food deficiency is taken care of by imports

Fig 6 Broad areas of fertile well watered plains are an important asset in a country s bid for world power

The soil makes possible a great variety of valuable foodstuffs, such as beans, corn, fruits, potatoes, rice, sugar, wheat, cacao, coffee, tea, opium, spices, tobacco, and livestock products From it comes directly or indirectly, the textile fibers with cotton, rayon, silk, wool, abaca, flax, henequen, jute, and sisal of greatest importance The fats and oils are also products of the soil, the more necessary of which are butter, lard, and oleo fats, and castor bean, coconut, corn, cottonseed, hempseed, linseed, olive, palm, peanut, poppyseed, rapeseed, sesame, soybean and tung oils All of these products hold a significant position in the economy of any industrialized state, especially if that political entity seeks to become a world power

Minerals —The value of minerals in the production of energy and their use as raw minerals in industry cause serious clashes between nations, they are bound to be more frequent as exploration and development of deposits is extended Next to agriculture, mineral resources are the most critical element in national sufficiency, regardless of whether a state is at peace or engaged in world conflict Economic sufficiency in minerals is improbable for any state because their distribution is so uneven in variety as well as in quantity Nations must depend on international trade and exchange to meet their requirements Minerals are exhaustable, and while reserves of some occur in adequate quantities, others may be expended during the present century unless they are used wisely and conservatively Declining domestic reserves is a specter which no state wishes to face because of the realization that the outcome of international conflicts depends largely on the availability of raw materials or adequate substitutes

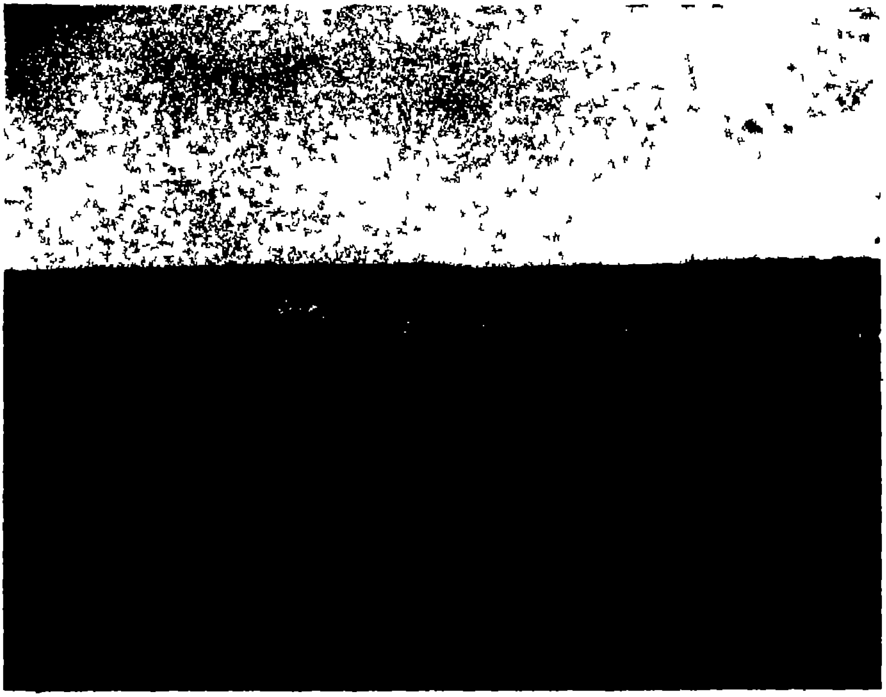


FIG 7 Fertile grasslands encourage settlement and tilled crops tend to replace the native vegetation

The Industrial Revolution gave a great stimulus to mining and although the number of commercially important ores was small, manufacturing nations offered encouragement to mineral explorations Among the many minerals now necessary for satisfactory economic development, bauxite, coal, iron, and petroleum hold first place in the economy of every industrialized state Other minerals occupying commanding positions are as follows antimony, asphalt, asbestos, chromium, cobalt, copper, diamonds, graphite, iodine, lead, manganese, magnesium, mercury, mica, molybdenum, nickel, nitrate, platinum, phosphate, potash, quartz, silver, sulphur tin tungsten uranium vanadium and zinc Unless a state possesses adequate domestic supplies of these minerals or has complete control of foreign deposits readily accessible at all times there is little possibility of that state ever becoming a world power

NATIVE VEGETATION

The distribution of native vegetation corresponds closely to the arrangement of climatic types Observation shows that forests grow most luxuriantly if rainfall is sufficient throughout the year with dense stands of large trees in the areas of greatest effective precipitation The forested areas give way to parklands and grasslands (Fig 7) where certain conditions of drainage and soil or external disturbances prevent normal tree growth also where with decreasing annual precipitation the seasonal distribution of rainfall becomes more marked As aridity increases the short grasses desert shrubs and numerous other drought resistant plants displace the tall grasses and forests of the sub humid regions

Fig 8 Ranching is the dominant industry in semiarid regions possessing nutritious grasslands

Ready access to forests and forest products is of much importance and states in possession of large stands of commercial timber are indeed fortunate because they can if necessary become independent of foreign sources The forests of every continent even Australia are being drawn upon more and more for lumber wood pulp and tannin Likewise the demands are heavy for camphor cinchona bark coconut husks cork kapok oil bearing nuts and rubber Then too the requirements of modern technology appear to grow even greater as more and more timber is converted into clothing plastics and numerous other products The large powers own or control most of the world s forests not only in the middle and high latitudes but in the tropical regions as well These same states also possess or control the vast grasslands (the Pampas excepted) which if carefully managed, are a constant source of wealth in the form of animal products (Fig 8) The world's pasture lands have outstanding value, especially where they form the major resource underlying the national economy of such countries as Argentina, Canada and Australia A large part of the humid grasslands in the middle latitudes have been brought under cultivation and now produce a substantial part of the grain needed in areas so densely populated that domestic food supplies are grossly inadequate

POPULATION

The physical factors already presented have in themselves no geopolitical importance unless mankind occupies the land Population, provided it has suitable capabilities and vigor, is without question the most important of the prerequisites for national power A state needs people, not only to settle upon the land, but to develop the available resources In periods of international conflict a nation must provide adequate manpower on the home front as well as on the battlefield However, it would be a serious mistake to consider population figures alone and disregard quality In some instances large numbers of people may prove a liability, especially when a state lacks suitable mineral resources and broad tracts of fertile, well-watered plains Another liability may be that of language differences since a diversity of languages tends to divide a population, thereby considerably weakening the power potential of a nation Switzerland is the outstanding exception

CONCLUSION

The conditions which bring about conflict between states are numerous as well as exceedingly varied and in most instances the contributing factors are closely mingled together International problems tend to become world-wide in scope Since both defense and offense are based largely upon human and natural resources in addition to technological advancement and industrial strength, the people of the United States must go forward with intense harmonized endeavors so as to make the country powerful and self-reliant In view of the fact that no state can maintain its economic and industrial life if denied free access to the world's widely scattered stores of raw materials, it is imperative that the American people adopt a strong position of preparedness as long as the possibility of international conflict remains A nation caught unprepared can no longer hope to secure adequate time to mobilize and prepare its defenses

Because the heavy demands of international conflict tend to weaken a state through rapid depletion of a wide variety of highly valuable raw materials, the United States needs to (1) possess a carefully prepared inventory of its total available resources in order to know, insofar as possible, the reliance the nation must place on extracontinental sources, (2) determine areas from which the country can draw vital materials, especially those localities accessible even in time of war, and (3) thoroughly investigate the possibilities of synthetic products so as to be in a position to replace if necessary the raw materials now secured from foreign countries Also a rigid set of conservation policies should be established in order to prevent the present serious drain on natural resources

The American people have a destiny but they must make manifest the pattern to be followed and demonstrate their moral greatness and political ability for world leadership Economic, political, and cultural ties with all parts of the earth must be recognized and their importance fully acknowledged. Each citizen of the United States has a personal stake in the fortunes of mankind—every action or policy of his Government will continue to greatly influence the order and magnitude of world events This nation, like any other, cannot escape the physical or moral effects of either peace or war, and therefore the big task ahead is to control these effects to the best advantage, a task which can not be accomplished without adequate foresight and military power

THE OHIO JOURNAL OF SCIENCE

VOL L MARCH 1950 No 2

ANTHROPOMETRIC EFFECTS OF RECORDED CASES OF MISCEGENATION AMONG CERTAIN CAUCASIAN SUB GROUPS

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The Galilee Skull discovered by Tiberius on the Sea of Galilee may link primitive man of the region of Asia Minor to Abraham Isaac and Jacob who successively wandered over the Plains of Mesopotamia With them begin the extensive migrations of the Jewish people

The households of Abraham Isaac and Jacob constitute the initial stock of the Israelites Famine drove them into Egypt where they were permitted to settle in the province of Goshen By 1600 B C the position of the Israelites deteriorated in Egypt Their religion may have been corrupt but it stood out in favorable contrast to the fantastic polytheism of their masters (Roth 1936) As a result of this Moses led the tribe from Egypt via the Red Sea to Palestine This happened between 1400 and 1200 B C The following 1500 years of sojourn in Asia Minor produced among the Jewish people another Oriental Scripture the Old Testament

Continuing from Palestine certain groups of Jews migrated to Armenia and the Caucausus Ripley (1899) reported records of their presence in this region one or two centuries before Christ Their first appearance in south east Russia was in the eighth century after Christ The Jews reached Ruthenia from the tenth to the eleventh century and arrived in Poland from the twelfth to the fourteenth century A small secondary centre of Jewish aggregation appeared about Frankfort this group having come via the Mediterranean and the Rhone Rhine Route (Fig 1)

Germany became divided politically and Russia interdicted them after 1110 A D Owing to the fearful persecutions all over Europe attendant upon the Crusades the Jews continued migrant The Polish kings desiring to encourage the growth of their city population offered the rights of citizenship to all who would come to Poland From Frankfort an exodus in mass took place toward the end of the sixteenth century Alarm then caused restrictive legislations in eastern Europe and since the sixteenth century the Jews have concentrated in Poland and in the eastern and southern European states for several hundred years (Ripley 1899)

From Spain many Jews went to North Africa particularly to Morocco and Tripoli Others migrated to the Balkans Cecil Roth (1936) reports that in 1492 an edict was issued that all Jews should be driven from Spain The same year the discovery of the New World opened another possibility of migration namely toward America However Jewish immigration to America gained momentum only toward the end of the nineteenth century (Fig 1)

Geographical distribution of the Jewish people of Europe and America during the nineteenth and twentieth centuries can be summarized briefly Toward the end of the nineteenth century there were between eight and nine million Jews in the world Of these six or seven million were in Europe the remainder being sparsely scattered over the whole world Fully one half of all these Jews resided in Russia namely four to five million Austria Hungary had two million Germany and Roumania had six to seven hundred thousand each The British Isles had only about one hundred thousand and these were mostly in London Scotland and Ireland had very few the number being one thousand to fifteen hundred a piece Holland harbored about one hundred thousand and half of these were crowded in the Ghetto of Amsterdam France had eighty thousand Italy had perhaps fifteen thousand Scandinavia had persistently excluded the Jews Toward the east and south of Europe the number of Jews decreased particularly in Egypt and Palestine which had been the ancient centres of dispersion

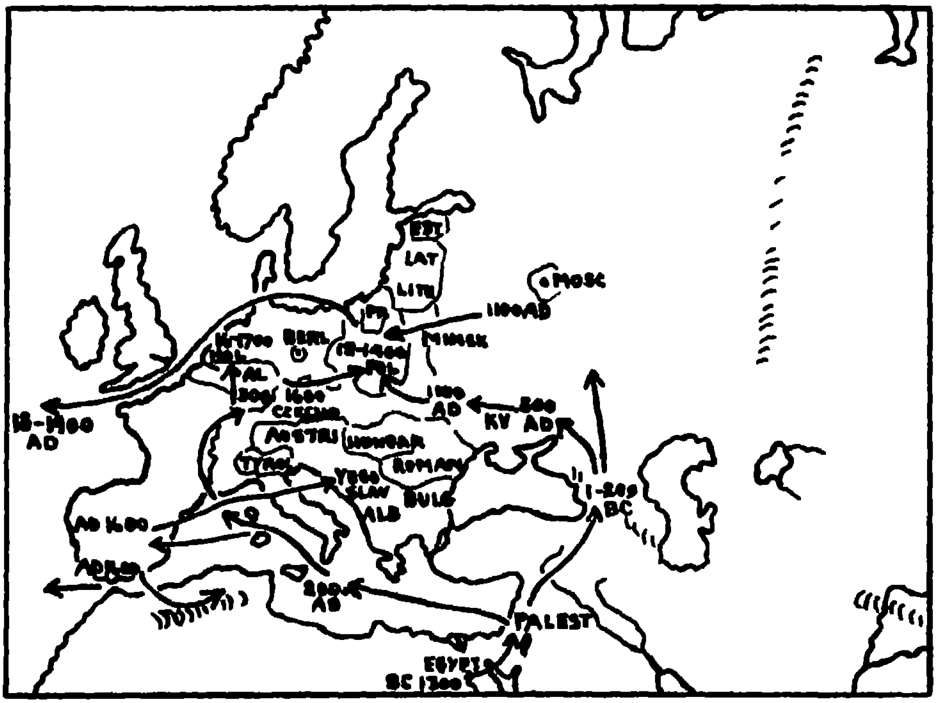

Fig 1 Routes of Migration of the Jewish people and their approximate dates

The main centre of gravity of the Jewish people in Europe of 1890 was in western Russia and Poland The numbers of Jewish people expressed as percentages of the total populations of the various countries were as follows The highest percentage approximately 15% appeared in Poland and Grodno Most of the west Russian provinces had from 4 to 13% while Hungary Frankfort and Holland showed 1 to 4% Countries which were mainly agricultural such as Sweden and the Tyrol had less than 0 1% These were the proportions of Jews in Europe toward the end of the nineteenth century

In the American colonies the number of Jews amounted to two thousand by the time of the War of Independence From 1881 to 1900 over six hundred thousand Jewish refugees from eastern Europe had landed in America By 1904 the Jewish population of the country had risen to one and a half million and by 1930 this figure was nearly trebled At this latter date, 1930, the population of Jews throughout the world was approximately fifteen million (Roth 1936) By 1914 the Jewish population of America showed considerable grouping in the major cities

The sojourn of European Jews during World War II, 1939 to 1945, has been recorded by the American Jewish Joint Distribution Committee of New York (1946) Almost six million Jews, it is stated, were wiped out in Europe during the six years of World War II The Committee estimates that of every ten in Poland in 1939 only one remained alive in 1945 There were 3,250,000 Jews in Poland at the start of the War At the end there were only 86,000 Many are found in Russia, Germany and Austria Germany in 1939 had 240,000 Jews The American, British, and French zones had a total of 72,000 Jews

Estimates by the Joint Distribution Committee on the way Jewish populations dropped in the war years are as follows In Belgium from 100,000, to 30,000, Czechoslovakia, 360,000 before Munich to 50,000, France, 300,000 to 180,000, Greece, 75,000 to 10,500, Holland 150,000 to 30,000, Latvia, 95,000 to 600, Lithuania, 155,000 to 20,000, Roumania, 850,000 to 335,000, Soviet Union, 3,020,000 to 2,000,000, Yugoslavia, 75,000 to 14,000

In a few countries populations gained mainly as a result of the influx of refugees from war-torn areas The number in England rose from 340 000 to 350,000, in Eire, from 4,000 to 4,500 Italy, 51,000 to 52,000 Portugal, 3,500 to 4,000, Sweden 7,500 to 22,000, Switzerland, 25,000 to 36,000 The Committee estimates roughly that 250,000 left the continent during the six years Of these it says 112,000 went to the United States and Canada, 36,000 went to Latin America, 100,000 to Asia which includes Palestine, and 2,000 to Africa and Australia

NATIONAL MISCIBILITY

The Jews are people without a country[1] They wander, not gregariously in tribes, and often not even in families They may scatter thousands of miles before striking root or becoming fecund True, the Jews bunch together where ever possible, and this has often been necessary for self-preservation Their enforced migrations and associations have changed them and their language Forced of necessity to adopt the speech of their immediate neighbours they have evolved distinctive speech wherever they they congregate in large numbers In Spain and the Balkan States they make use of the Spanish In the interior of Morocco they speak Arabic while in Russia and Poland a degenerate form of German has become Yiddish Despite these difficulties they still constitute a distinctive social unit wherever they chance to be

Furthermore in their migrations they have not suffered assimilation and absorption, on the contrary they have added greatly to their numbers by the absorptions of others in countries where Jews were alien For instance in 1740 A D the Khan of the Khazars (who lived north of the Black Sea) was converted to the Hebrew faith, and subsequent mass conversions of these Alpine Asiatic-followers created a great admixture of the Jews (Taylor 1938) To cite another similar instance one may mention the conversion of the Falashas of Arabia in Yemen

In the early days of Judaism marriage with non-believers was not invalid, as it later became Such irregular marriages with, and conversion of Christians are abundantly on record Even despite prohibitive legislation, thousands of marriages with Christians are reported in Hungary in 1229

Great importance was attached by the Jews to an early classification of themselves The Polish types, an admixture of Hebrew, Hindu, and Khazar sources, still call themselves *Ashkenazim*, while the Spanish *Sephardim* alone were held to be truly Semitic Which of these two was the primitive type of Palestine is a moot question, (Ripley 1899)

Thus the origin of the modern populations of the Jewish people is as diverse as the types of the various peoples that have been assimilated Pittard (1927) states that the Judaized people have come from every kind of ethnic stratum such as the Falashas of Abyssinia and the Germans of Germanic type or the Tamils—Black Jews of India and the Khazars supposedly of Turki race

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[1] Israel as a country belonging to the Jews has been recognized officially only since 1948

VARIATIONS OF PHYSICAL CHARACTERISTICS AMONG JEWISH GROUPS FROM VARIOUS GEOGRAPHICAL REGIONS

Pittard (1927) states that at the present time there is no single Jewish community in the world which has been genetically isolated from admixture with Jews from other communities since the period of its first formation For this reason we cannot assume that any one group of Oriental Jews is fully representative of the Palestinian Jews of the time of Christ If however we study the Jews of the Mediterranean world both separately and as a group we should be able to find the common racial denominators which will reveal to us the physical characteristics of their united ancient Jewish ancestors Let us begin with the present day Palestine where although representatives of every type of Jew have come together there is a complete historical continuity of Jews from the time of Christ

THE MODERN SAMARITANS OF PALESTINE

The modern Samaritans of Palestine who are generally supposed to represent the indigenous Palestinian strain more faithfully than any other are tall with a mean stature of 173 cm (Huxley H M 1916) and mesocephalic (C I 78) with heads similar in dimensions to both Yemenis and Mesopotamians Their faces are moderately long (125 mm) and narrow while their thin foreheads are of moderate breadth (103 mm) Their noses are leptorrhine (N I 66) and of moderate dimensions

In pigmentation the Samaritans show more than the usual Mediterranean 25 percent of partial or incipient blondism Only seven out of 35 had black or dark brown beards the rest were brown blond and red In eye color one third were light or mixed the rest were equally divided between dark brown and brown

The general body of Oriental Jews however is less tall and less blond than these comparatively specialized and inbred Samaritans Weissenberg (1915) in a general series of Palestine Jews found no blondism and the short stature of 150 cm combined with the mean cephalic index of 79 8 extremely narrow faces (128) mm) and a nasal index of 61 Convex noses of a type which he designated as Semitic are found in 78 percent of his series

THE YEMENITE JEWS OF SOUTHERN ARABIA

The Yemenite Jews of southern Arabia form the only large colony of this people in Arabia Here the city Jews of Sanaa are for the most part short slender people light skinned but purely brunet in hair and eye color The commonest shade of hair is black and of the eyes dark brown In stature and in cranial and facial dimensions they resemble the Palestinian Jews greatly except that the brachycephalic element is almost entirely lacking The mean cephalic index of the Yemenite is 74 Their faces are small with a total face height of under 120 mm and a bizygomatic of 130 mm In Weissenberg s series 60 percent had straight nasal profiles and a few even concave

There are two types of Jews among the Yemenite group The more numerous is only moderately slender often well muscled in the extremities The face is short and of moderate breadth the chin well developed lips of medium thickness The nasion depression is medium and the browridge noticeable but not heavy The eyebrows are thick and convergent the eyes deep set and the palpebral opening is sometimes narrow The second less numerous type is lighter in weight and slenderer with small hands and feet an extremely narrow head projecting occiput and a sweeping curve for the forehead in profile The face is long and very narrow the mandible slender the lips thin the nasal tip somewhat depressed the nose extremely long with compressed wings and the nostrils highly set on the sides Although the nasal profile is convex the bridge of the nose is not unusually high Both types are almost purely brunet in hair and eye color, both are brunet-white in skin color The first type is somewhat heavily bearded, while in the second facial hair is usually sparse The Jewish appearance of the coarse type is concentrated in the eyebrows eyes and mouth, of the fine type in the nose

Coon (1939) states that although there is no doubt that much local blood was absorbed into the Jewish community by conversion in the pre-Islamic days it is not difficult to distinguish a Jew from an Arab in Sanaia, a city of Yemen Two other characteristics which occur among Jews are a high attachment of the nasal wings on the cheek with a great lateral visibility of the septum and a characteristic slant to the ear in both the frontal and lateral planes In addition to the features listed there seems to be a characteristic facial expression a Jewish facial behavior centred about the eyes nose and the mouth

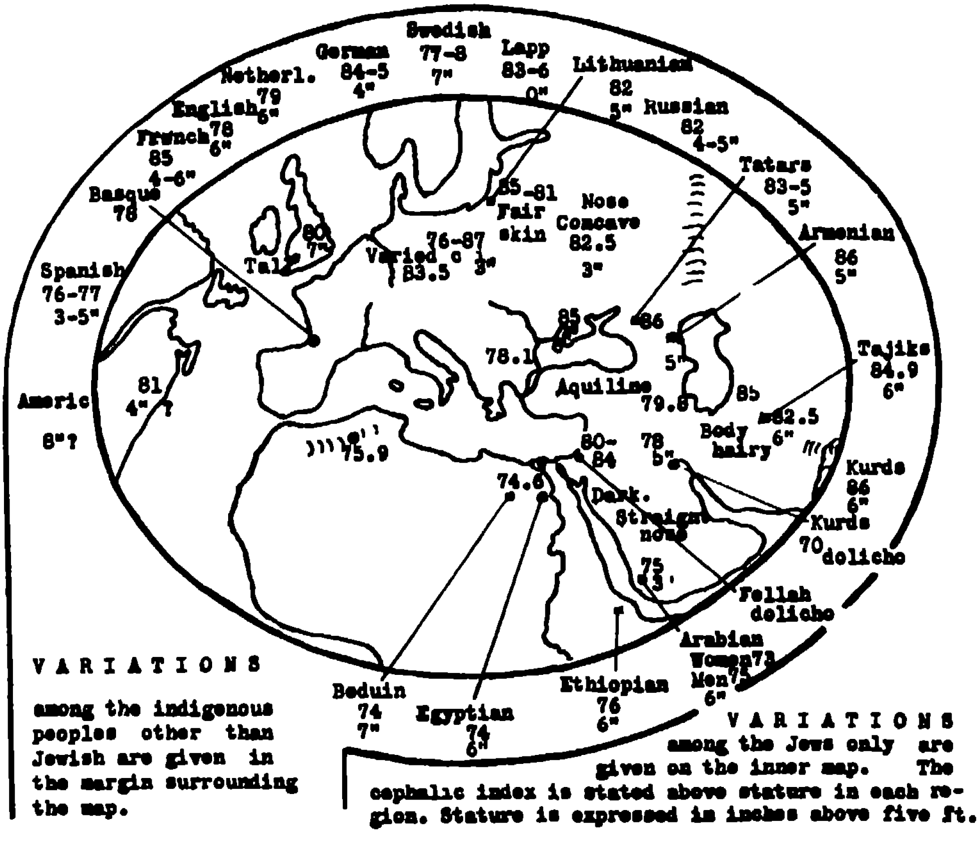

Fig 2 Variations of physical characteristics of different Jews compared to the traits of the indigenous peoples of various geographical regions

THE NORTH AFRICAN JEWS

The North African Jews are on the whole taller than those of Palestine and Yemen, with a mean stature almost uniformly between 164 and 166 cm their cephalic index is 74, and very few are brachycephalic No more than five percent show evidence of blondism

THE JEWS OF TURKESTAN AND AFGHANISTAN

The Jews of Turkestan and Afghanistan are fully brachycephalic with a mean cephalic index of 85 They are of moderate stature 166 cm nearly the same as the Tajiks among whom they have lived for over a millenium But they are narrower shouldered than the Tajiks shorter trunked and longer legged their bodily proportions preserve more of a Mediterranean racial character Their heads are short 180 mm narrower than those of the Tajiks with a mean breadth of 153 mm Despite their brachycephalization they have preserved distinctive traits of face their minimum frontal mean is 104 mm their bizygomatic 139 mm and bigonial 104 mm Thus they are narrower in all three dimensions than their non Jewish neighbors but a little wider in the essential facial diameters than the long head Jews Their interorbital (31 3 mm) and biorbital (90 9 mm) diamteres are narrower than those of other central Asiatic peoples they have thus also preserved the original Jewish narrowness between the eyes Their faces with a mean length of 125 4 mm are two mm longer than those of their neighbors their noses with a mean length of 57 mm are also two mm longer Their facial index of 90 5 is leptoproscopic their nasal indexis 62 which is three to four points lower than those of the narrowest noses of the other peoples of Turkestan with whom they are in contact

Metrically therefore it would be wrong to infer from the cephalic index alone that the Jews of Bokhara Turkestan are simply Judaized Tajiks or Judaized Turkestan people in general What they actually are is brachycephalized Jews who have preserved their Mediterranean facial characters almost intact (Coon 1939) The agent of brachycephalization is the same Alpine element as exists among the Tajiks

They are almost all brunet white in skin color lighter than the Tajiks in eye color 57 percent are purely brunet and mostly light brown Fifty percent have black head hair fourty percent have dark brown hair and another ten percent brown to blond In their general pigment character they are approximately the same as the mountain Tajiks but lighter than those of the oases They are as heavily bearded as the Tajiks and as abundantly supplied with body hair

JEWS OF THE CAUCASUS

The Jews of the Caucasus are highly brachycephalic with cephalic indexes of 85 and 86 Their mean stature ranges from 163 to 166 cm and their faces are broader than those of the Bokharan Jews They are however still extremely leptorrhine and have straight or convex nasal profiles

THE KARAITE JEWS OF THE CRIMEA

These Crimean Jews have a stature of 164 5 cm their mean cephalic index is 85 and the nasal index is 60 Five percent are light in complexion Karaites living outside the Crimea have failed to preserve their characteristic metrical position Those who settled in the Egyptian Delta have a cephalic index of 74 6 while those of Lithuania have a cephalic index of 81 and a stature of 162 cm fifty five percent have fair skin color and an equal amount of mixed hues Over fourty percent have also brown or light brown hair color Concave noses the antithesis of a Jewish condition are found among fifty percent while nasal convexity is almost entirely absent

THE ASHKENAZIM JEWS

Ashkenazim Jews seem to show that characters such as stature may be environmentally and socially conditioned In western Europe mean statures for regional groups vary from 162 cm to 167 cm In a rough way the stature level corresponds to that of the local Gentiles but is one or two centimeters lower in each region In Europe indoor workers have the smallest statures and professional men the tallest In England where the Jews have enjoyed relatively favorable living conditions the stature rises to high levels Rapid dize increase on American soil, in response to better living conditions, may be partly interpreted as a fulfilment of their genetic possibilities Similarly inferior chest diameters of the East European Jews are seen to rise to non-Jewish standards in America

Head form of the Ashkenazim is relatively constant In Germany the mean cephalic index for Jews is about 81, rising to 83 5 in Baden and Galicia, and in Bukovina it attains 84, but elsewhere from Austria to the Ukraine and Lithuania it centres about the mean of 82 There appears to be slight tendency for the cephalic index to vary regionally as does that of the corresponding Gentiles Generally in central and eastern Europe Jews are less brachycephalic than the Gentiles

Pigmentation of the Jews shows constancy Approximately fifty five percent are of dark hair and eye color combinations, and less than ten percent can be construed as blond In countries where the Gentiles are predominantly blond, the Jews are relatively dark, and in countries such as Roumania, where the Gentiles are prevailingly brunet, the Jews are more blond than the Gentiles

Convexity of nose, a popular diagnostic of Jews, is usually found in far fewer than fifty percent, straight noses are in all regional Jewish groups the commonest profile forms, while in southern Russia concave profiles are more frequent Among Russian Jews it is not difficult to select individuals with large malars, broad snubbed noses and high alveolar segments of the upper face, who are as nearly Mongoloid as many Volga Finns

Among German Jews may be found individuals who are to all purposes Nordic, and others who belong to the Borreby race, which is the most numerous single type among Gentiles in Germany Alpine Jews are commoner than the incidence of Alpines in central and eastern Europe would perhaps warrant, and some of their Alpinism must have been derived from their sojourn in France and in the Rhineland before their march eastward across central Europe On historical grounds it is very likely that the ancestors of the Ashkenazims mixed more with the Gentiles in western Europe, before the time of the first Crusades than their more recent forebears have in Slavic countries The heavy beard growth, the abundance of body hair, and the wavy hair form of many brachycephalic Jews imply a French or German Alpine infusion

The Jewish people as a whole represent a blend of several or many of the racial types discussed which in a subtle manner gives them the Jewish appearance

The central European Jews have lived in central Europe since the beginning of the period when the Germans and Slavs began to grow brachycephalic Their recent racial history has run parallel in time to that of their Gentile neighbors, in comparison with whom they must have remained relatively constant The modifications which the Jews have undergone in one generation in America are as great in some respects as those which have affected their ancestors in twenty (Boas 1913 Morant and Samson 1936)

SUMMARY

A study of the main physical characteristics of the indigenous stocks of various regions and the corresponding characteristics of the Jews that have lived among them in these regions indicates that the Jews are of heterogeneous types each of which conforms to a greater or smaller extent to the indigenous physical types The following examples can be located with greater clarity by observing Fig 2

1 The stature, cephalic index, and abundance of body hair among the Jews of the Turkestan runs almost parallel to the same characteristics which are common to the indigenous Tajiks
2 The strong brachycephalization and medium stature of the Jews of the Caucasus is almost the same as that of the Tatars who are at home in this region
3 The heavy hooked nose of the Jews of Asia Minor or Turkey has its equal among the Armenians

4 The dolichocephalic condition of the Jews of Egypt is very similar to that of the native Egyptians and Beduins

5 The frequency of fair skin and head hair among the Jews of Lithuania is not surprising among the Lithuanians

6 The dark complexion and straight nose among the Jews of Arabia as well as their cephalic index of 75, is common among the Arabs In the southern part of Arabia at Aden the Arabs consider the native Jews as part of themselves

7 The high percentage of concave noses among the Jews of Lithuania and southern Russia is not a Jewish characteristic among Jews of the homeland, but it is a characteristic of the Russians

8 In England the stature of the Jews has surpassed that of almost any other group of Jews elsewhere

9 In America the cephalic index of the Jews has been proved to undergo changes which help to understand the possibility of similar changes in other geographical regions

What may the causes be that bring about these differences among the Jews? An explanation that would not violate the present knowledge of Genetics is that the indigenous peoples that have become assimilated by the Jews in various geographical regions have contributed their genes to the present inherent Jewish genetic make-up That assimilation of even large numbers has occurred is undeniable Another explanation that gains support in recent researches (Boas and Weidenreich) is that of persistent regional modifications due to improved conditions in occupation, nutrition, and climate If perceptible changes in physical stature and cephalic index are evident as a result of a few generations under new conditions two hundred to a thousand years must surely leave their mark

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CULTURE CHANGE IN LOMA A PRELIMINARY RESEARCH REPORT[1]

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"Loma," "Justino" County, Southwest, is a relatively isolated community of some 200 people (40 families) Most of them are Spanish-speaking, the rest are "Anglos," non-Spanish, English-speaking "Whites" The community lies 7,000 feet high, in a little valley stretching across a state road, which, in rainy weather, it is a special art to travel

Almost all Spanish persons were born in Justino County, and a majority in Loma itself The Anglos are much more heterogeneous in this, as well as in many other respects, even occupationally one is a trader and store owner, his wife running the post-office, another rents cabins, but all also farm The Spanish people make their living farming and doing wage work outside Loma (most of them combining both), especially sheepherding, sheepshearing, and potato picking Land is the chief property Anglo acreages and values are higher than Spanish, but there is much variation within each class

For about 40 years, Loma has had a public grade school The church (Catholic), only some ten years old, is a "mission" of the Justino parish Mass is held once a month, not on a Sunday, by an Anglo priest The Anglos belong to various non-Catholic denominations or to none

People look lean, and many are bony At least the Spanish diet is deficient Sickness is widespread Much of it is undiagnosed Infant mortality is high Birth control is practically unknown

Loma history has few specific dates Some tenants lived in the locality as long as 120 years ago Water rights were granted by the Mexican government Soon the first irrigation ditch was dug, and about 60 years ago, an Anglo pioneer dug the first well The most far-reaching event was the establishment of the National Forest early in this century It eliminated sheep and goats by pre-empting grazing lands and pasture thus depriving the Lomans (*Lomeños*) of basic sources of income of meat, milk, and cheese for food, of wool for spinning and weaving and, indirectly, of spinning, weaving, and related skills The next important change factors, more difficult to date, were the introduction of the automobile and the less directly significant contacts with other urban inventions—

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[1] This paper read at the Twenty fifth Annual Meeting of the Central States Branch, American Anthropological Association, Indiana University, Bloomington, May 13 and 14, 1949, is a very concentrated synopsis of some parts of a large-scale monograph on Loma designed to develop and document a conception of social science, especially sociology and cultural anthropology, and particularly the study of culture (Other parts of the monograph already published are "A Methodological Note on the Empirical Establishment of Culture Patterns" *American Sociological Review* 15 10 176–184, April 1945 and 'The Unique and the General Toward a Philosophy of Sociology *Philosophy of Science* 15 192–210 July, 1948) Field work in Loma was done in 1942 and 1944 in 1944 on a Social Science Research Council fellowship Writing up was begun in 1948 and 1949 under grants from The Viking Fund Inc and the Graduate School of The Ohio State University In the summer of 1947 a graduate student spent several weeks in Loma under the joint supervision of Dr John W Bennett and myself (all of Ohio State University) material collected by this student is part of the sources utilized here as well as in the first volume of the monograph written up thus far To these organizations and persons I gratefully acknowledge my indebtedness

This paper, probably will appear to be largely impressionistic, due overwhelmingly, if not wholly to the impossibility of anything more than very slight documentation, in view of the time limitations under which it had to be presented, even the methodology employed could be indicated if at all, only by implication Reference for full documentation must therefore be made to the forthcoming monograph radio, magazines, dance halls with their nickelodeons in Alta (the nearest community to the south), the movie in Justino, and latest, electricity In most of these diffusions, federal and county agencies and the Loma Institute were instrumental

The defunct Farm Security Administration was the most important federal agency economically and, in conjunction with other farm-improving services, for reforms in agriculture as well People recognized this the FSA made more sense to them than did any other effort Individuals who benefited from it also rated WPA highly The Soil Conservation Service has met with some interest, but most of the plans discussed in connection with its District have not yet materialized The County Agent, according to the individual who occupies the office, may function as merely one of the numerous vague entities called "government officials" or as an intimate friend and adviser

Justino, the seat of all these and other governmental agencies, also houses the tax authorities On the whole, they are felt to be functionaries of a vast and fateful power In 1940, more than half the farms in the county had become the property of the state for back taxes, often without the knowledge of the original owner For Loma, the figure may be as high as one-fourth In 1941, the percentages which taxes represented of incomes ranged from one to 75

Directly or indirectly, the agencies try to introduce a foreign-imposed type of community organization of a non-traditional, non-religious, non-feudal, non-Spanish type Yet it was the Justino Plan and the Loma Institute which were most intent upon improving conditions by rational measures The Plan, which operated for about three years during the early 1940's, obtained 'problem lists' from representatives of all communities in the county It cooperated with the other agencies, public and private, and with the people in the communities themselves In Loma in 1942, the most urgent problems, according to the residents were water scarcity, with the building of a reservoir and the adjustment of ditches given highest rating as suggested solutions, inadequate education, with additional teachers named as a measure of improvement, and poor health The Justino Plan did various things in regard to these and many other problems, and ever since its demise, several efforts have continued

The Loma Institute, created and directed by a midwestern Anglo teacher and his wife, was more intimately connected with the community directly It developed through money gotten together by means of summer camps, frequented by boys and girls from as far away as New York Later, a year-round grade and high school was run, mainly with local Spanish students Due to the scarcity of personnel decimated by military service, and to shifting interests on the part of the few individuals left, the Institute altogether lasted only five years Yet while running it was engaged not only in formal education but also in various other community activities, such as the 4-H Club, health clinics, the establishment and supervision of a community center, dances, and the like Aside from direct give and take, the most outstanding means of communication between the Institute and the community was a newspaper, *The Lomeño* Written and mimeographed by staff and students, it gave expression, particularly, to the Institute's emphasis upon participation in political life, local, county, state, and national

In spite of these efforts, however, planning and organized cooperation in matters where they were not traditional (as, for instance, in irrigation) remained foreign to the people Here, however, the narrative must be interrupted, in order to insert a methodological note or, perhaps, to confirm an observation made by the reader, namely, that what has been said thus far refers mainly to the Spanish people of Loma Beyond showing this awareness, it is not possible to do more than to point out, rather peremptorily, that the reason for this preferential treatment is Loma's being a predominantly Spanish community, in more than one respect, and to state that from now on, the Spanish society and culture of Loma exclusively will be dealt with To resume the argument, then how much planning and organized cooperation remained foreign to the *Lomeños* is suggested by the answers to questions concerning their community, asked of them in 1942 One question was "How much land do you think is needed for raising enough animals and crops to supply yourself and your family without having to go outside for wage-work?" Answers to it ranged from 15 to 250 acres Another was "Given the cultivable land and the water available, how many families do you believe can make a living in Loma without having to go outside for work?" Replies ran from two to 25 families Still other questions resulted in comparable answers all showed polite compliance with the type of request that was made, but did not go beyond this, toward a more empirical preoccupation with the topics brought up

Almost all that has been said illustrates Loma culture change Anglo-carried phenomena—economic, technological, industrial urban—act upon a culture formerly not so impressed This impact is both local and pervasive (Cf Fig 1) Among the local elements, in chronological order, are Anglo-derived education, the National Forest, the Anglo-operated trading post and store, the post office, the

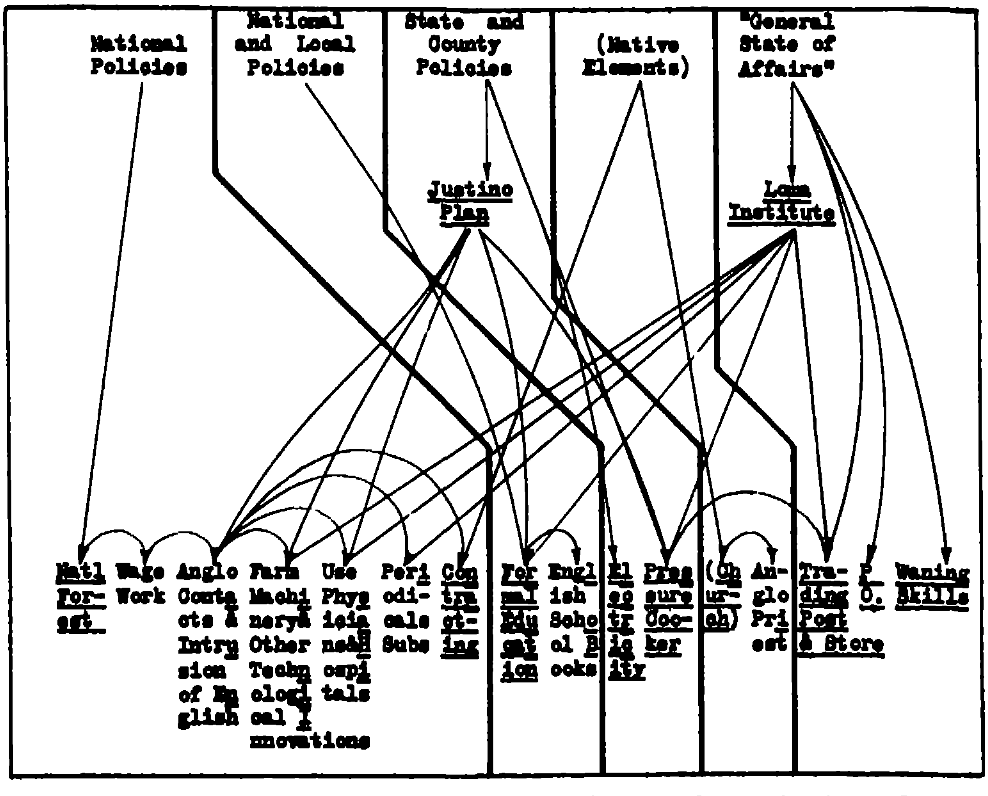

FIG 1 Elements in the Process of Loma Culture Change The top line lists influences (whose preponderant direction is indicated by arrows) outside the local change system, with the possible exception of the vague last, 'General State of Affairs The bottom line lists elements operating in the Loma culture as of 1948 (and thereafter) These elements are shown in their connections with one another, as well as with the influences listed on the top line Two elements (Justino Plan and Loma Institute) are placed in an intermediate position to indicate that they were no longer in existence in 1948 Underscoring indicates the fact that the item can be traced only to an influence outside the local change system non-underscored items can be traced to influences within this system The—undoubtedly existing—influences of items on the bottom line are not indicated except for a few specific ones (the chain leading from National Forest to Contracting the introduction of English School Books through Formal Education of the Anglo Priest through the Church and of Pressure Cooker and Post Office through the Trading Post and Store) The parentheses around Church indicate that this element is native

Anglo priest, and the short-lived Justino Plan and Loma Institute More pervasive elements, in approximately chronological order, are the intrusion of English and of English school books, the appearance of outside wage work the waning of handicrafts, contracting farm machinery the use of physicians and hospitals, the introduction of sewing machines, pressure cookers, and other household appliances, of magazine and newspaper subscriptions, and of electricity

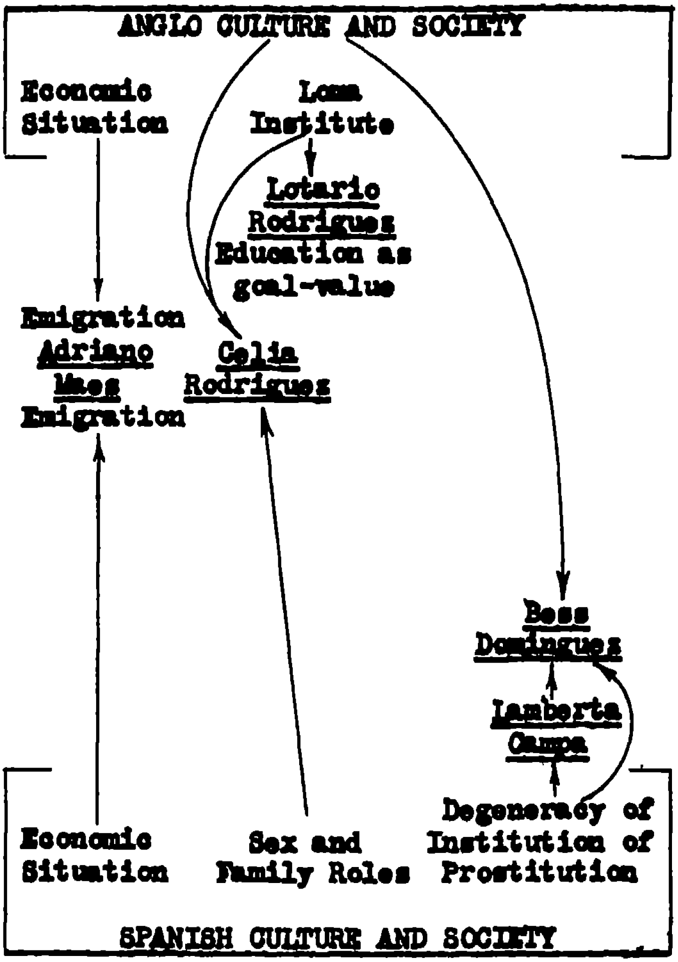

FIG 2 Elements in the Process of Culture Change on the Part of Five Lomans The positions of the five individuals diagrammed symbolize their respective "nearness" to Anglo and Spanish culture and society, respectively Arrows indicate preponderant direction of influence

In a much more intimate fashion, the process of this change is shown in life histories (see Fig 2) and in compositions written by upper-grade school children Lotario Rodriguez, a twenty-year old boy who graduated from the state university (thus far the only Spanish Loman to do this), exemplifies a change of Loman culture through the incorporation of (Anglo) education as a goal-value Another type results from socio-economic change It is illustrated by several young married men, for instance, Adriano Maes, who emigrated, probably for good, preponderantly on economic grounds A third type, perhaps, is represented

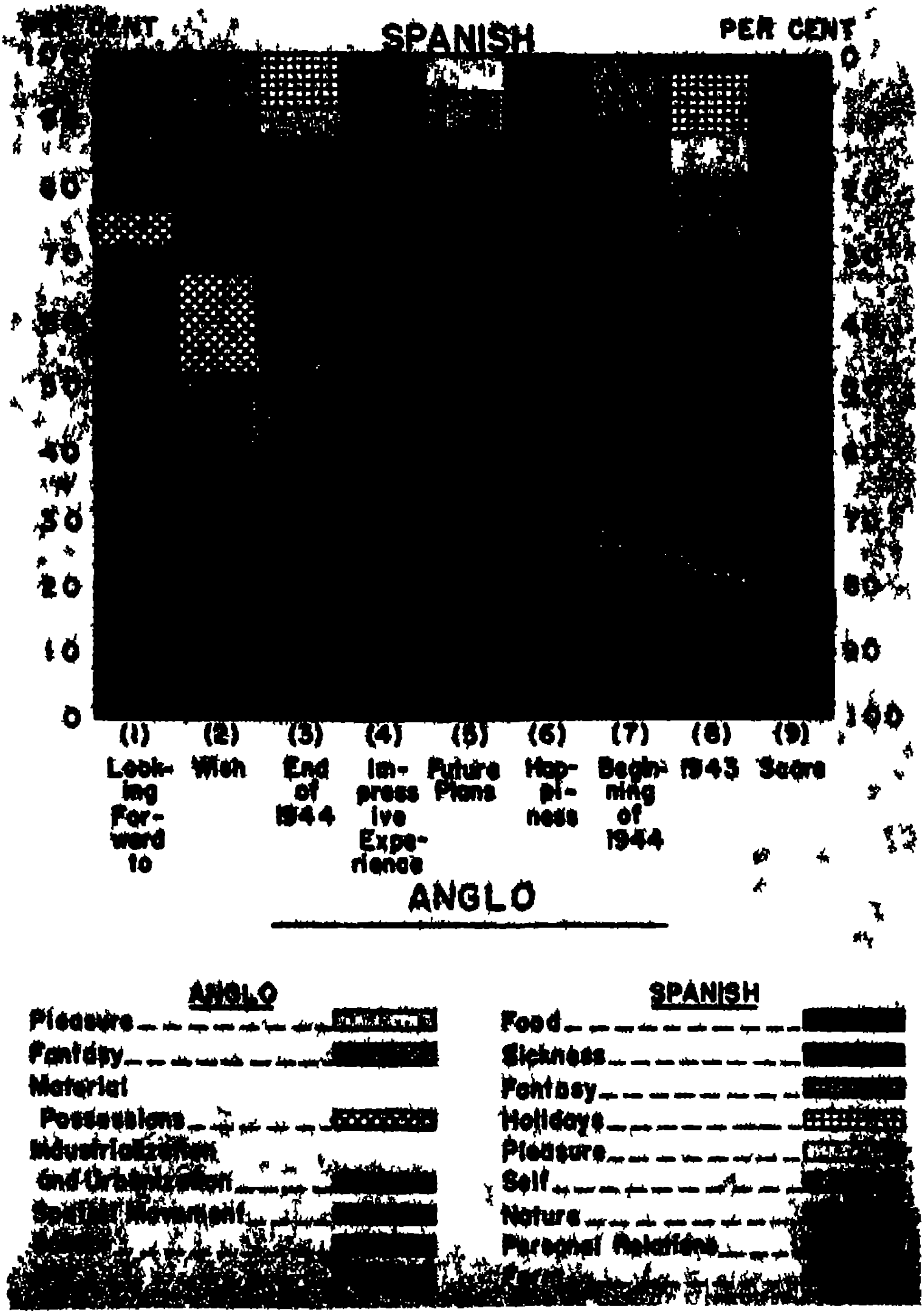

FIG 3 Percentages of Anglo and Spanish Components of Responses by School Children to Nine Stimuli Loma 1944

by Lotario's younger sister Celia While her brother may be said to participate in two worlds, Spanish and Anglo, Celia's outlook seems little Anglicized in spite of her equally good English and other "participations" in American culture In part, this is due to her being a girl As her most impressive experience, she recalled the onset of menstruation and the fatal accident of a younger sister—whereas the brother's most fundamental change, as interpreted by him, consisted in the process of education, and he did not even mention the sibling's death Finally, there are two persons, mother and daughter, Lamberta and Bess, whose lives are almost exclusively definable in terms of a decaying institution—prostitution, which may be presented as the Lomans' handling of one component of human nature—evil, especially sex Lamberta, the mother, although she has initiated a large number of boys into the sex act, is treated like any other villager, in a friendly ordinary manner But her role is no longer stable and clear Lamberta is cautious, diffident, confused Furthermore, while she emphatically asserts her complete agreement with church doctrine, including confession, her daughter, as yet unmarried, favors divorce, uses the expression "none of the priest's business," prefers Anglos, would like to marry one, is strongly attracted by the "city" but at the same time attached to her mother and the "folks" She has no longer any idea of "human nature," whereas her mother is still bewildered by it—already bewildered by it, if in turn, Lamberta is seen against the past

The children in the fifth to eighth grades were asked (by the substitute Anglo teacher) to respond to the following stimuli "What are you looking forward to?" "What do you wish for most?" "Make a calendar for the rest of this year (1944) " "What made the greatest impression on you?" "What are your plans for the future?" "Describe when you were most happy " "Make a calendar for the past part of this year " "Make a calendar for last year (1943) " "Describe when you were most scared "[3] The answers to these questions were analyzed in regard to Anglo and Spanish components posited, on the whole, on the basis of an "image" of Loman culture which had been gathered by staying in the community and which is subject to checks yet to be applied The list just given is in the order of decreasing Anglo percentages (Cf Fig 3) In the "looking forward to" question they amounted to 77 per cent, the then current war figuring overwhelmingly Next (72 per cent) came the "wish," with the war likewise preponderant, but with a close-by tie between desires for spatial movement, mainly trips, and material possessions Next (57 per cent) came the calendar for the end of 1944, with war once more strongly in the lead Next (46 per cent), the "most impressive experience," with the reflection of industrialization and urbanization in various respects being clearly prominent Next (40 per cent), "future plans," with spatial movement outstanding Next (33 per cent), "happiness," with the war slightly surpassing industrialization and urbanization Next, the calendars of the past part of 1944 (30 per cent) and of 1943 (26 per cent), with school experiences ranking uppermost, finally, 18 per cent of the children's "scare" memories were Anglo components, equally connected with the war and with aspects of industrialization

Of the complementary Spanish elements, fantasy was most important in the 23 per cent of the 'looking forward to" question, personal relations, in the 28 per cent of the "wish", farm matters, in the 43 per cent of the calendar for the end of 1944, nature, in the 54 per cent of the "most impressive experience", again farm matters, in the 60 per cent of the "future plans", personal relations, in the 67 per cent of "happiness", the farm once more, in the calendars of the past part of 1944 (70 per cent) and of 1943 (74 per cent), and nature, in the 82 per cent of the "scare" memories

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[3] A good deal of explaining was necessary to make these questions understandable This, along with the class room context the teacher's personality, and similar factors made for an important situational impact upon the answers which, however, could not be measured A consideration such as this is only one among many which went into the technique of analyzing the children's answers in regard to Spanish and Anglo components The technique cannot be described here

If the overpowering contemporaneous event, World War II, as well as all items amounting to less than three per cent each of the components in either the Anglo or the Spanish class, are eliminated, the children's answers can exhaustively be classified into three Anglo items, totaling 37 per cent of all components, namely, the school, spatial movement, and industrialization and urbanization, and into four Spanish items, totaling 63 per cent, namely, personal relations, the farm, nature, and the self The Anglo components reflect, respectively, interest in an institution, expressions of attitudes, and impacts of a process The Spanish components reflect social relations ("personal relations" and, as an inspection of the children's answers indicates, 'self") and institutions ("farm' and "nature"[3])

The analysis of culture change has thus led to a confrontation with Loman culture itself As this culture emerges from an analysis of the children's compositions, and from the life histories, it would appear to be a culture which in the way described, has both Anglo and Spanish components But this statement anticipates a good deal For it is based, also, on answers to questions which have not been discussed here, as well as on the largely unknown impact on the answers given, an impact called forth by the situation in which the questions were asked The validity of statements concerning Loman culture can be increased only if it is possible to formulate them in a less tentative and more intelligent and justifiable fashion This, in turn, can be done only if Anglo-Spanish relations are more intimately studied—if, that is, the structure of the Loman social system is better understood

At this stage of analyzing the data, neither this nor the many other things that need being worked out and clarified have been done What has been presented, therefore, stands pending the solution of these tasks, since it has been elaborated to the point, it would seem, where it can be revised only upon their completion

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[3] By "institution is understood here, a unit, within a socio cultural context, which contains social and cultural elements (individuals and their relations and their interpretations) and which also may contain elements of the natural environment a unit which must "be counted with' by the participant individuals It may be suggested that while in Loman culture, Nature is an institution in this sense it is not an institution in the typical urban culture although it is one (with, however, variable contents), perhaps in rural culture generally and very probably in the Anglo culture of Loma

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ATTEND THE

Ohio Academy of Science Meetings

April 28 and 29, 1950

CAPITAL UNIVERSITY - COLUMBUS, OHIO

VOLUMETRIC AND GRAVITY SLIDE TESTS FOR AIR-BORNE RAGWEED AND OAK POLLENS AT COLUMBUS, OHIO

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A more or less recent phase of atmospheric pollen research has been concerned with deriving a mathematical formula or a conversion factor with which gravity slide data[2] could be converted into equivalent volumetric units Data so reported would be of greater value to allergists since the degree to which a patient is sensitized greatly depends upon the number of antigenic pollen grains entering the individual's lungs Scheppegrell (1) in 1917, reported a conversion formula (partially derived by use of Stokes' law of falling bodies) for converting data obtained from freely exposed[3] gravity slides into equivalent volumetric units Cocke (2) later corrected a mathematical error in the formula, and both Cocke (3) and Hawes (4), following simultaneous gravity slide and volumetric tests, reported that their experiments proved the validity of the use of the Scheppegrell-Cocke formula even when the specific gravity of the various pollens was considered as 1 0 However, Rosendall, *et al* (5), reported that the factors derived from Scheppegrell-Cocke formulas were also incorrect in certain instances Dahl (6) then pointed out the inadequate knowledge concerning the specific gravity of the various pollens, and suggested that the assumption that this was approximately 1 0 might be incorrect and have a great deal to do with the apparent inaccuracies of the Scheppegrell-Cocke formula He also pointed out that little was known concerning the relative rates of fall of the various pollens and suggested that no further progress could be made with the problem until the actual specific gravity of the pollen grains of different species, as well as their particular rates of fall in still air, could be determined experimentally This information was supplied by Durham (7, 8) He found that the specific gravities of tree pollens are approximately 0 9, and those of most grass pollens are about 1 0, however, the specific gravity of ragweed pollen is approximately 0 5 Consequently Durham stated " that calculations already made by Scheppegrell, Cocke, and Dahl, who have used Stokes' law for determining the rate of fall and number of pollens per cubic yard of air, may be expected to give reasonably accurate results for some tree and grass pollens, whereas they are evidently in error for the ragweeds "

The next step was to calculate theoretical atmospheric pollen concentrations by the use of the Scheppegrell-Cocke formula in which the experimentally determined specific gravities were included, and then compare these data with the actual concentration as determined experimentally This was also done by Durham (9) He found great differences in the daily ratios as determined by the two methods, and concluded that " the Scheppegrell-Cocke-Dahl tables are of no practical value in converting gravity slide figures to accurate volumetric equivalents " Durham's volumetric determinations were known to be essentially correct, therefore the large differences in the comparative ratios must have been the result of large errors involved in the gravity sampling procedure This was in many instances verified by his data which indicate that on days of approximately the same degree of atmospheric ragweed pollen concentration the catch on the freely exposed slides usually varied directly with the wind velocity Durham also exposed a set of gravity slides in various positions and found that a slide placed in a horizontal position with the coated side down collected approximately half as many pollen grains as a horizontal slide with the coated side upward This led Durham to conclude that convection currents, deflection currents, and wind eddies must interfere with a horizontal flow of air hence with the deposit of pollens and spores on the gravity slides Since the gravity slide method of sampling is by far the simplest and most convenient method so far devised, Durham proceeded to construct a collector which would decrease the turbulence over the slide and consequently result in a more uniform collection of pollens (10) Simultaneous gravity slide and volumetric collections were made during the ragweed season of 1945 using this new gravity slide sampler, and the comparative ratios were found to be much more uniform The catch per cubic yard averaged 3 6 times greater than the catch per square centimeter of gravity slide, and Durham submitted this as a conversion factor for calculating the volumetric incidence of ragweed pollen when this type of sampler was used in areas where short ragweed is predominate He further concluded that conversion factors for other pollens would be comparable to that of short ragweed in proportion to their relative rates of fall, and on this basis presented a table of conversion factors for some 40 important etiologic hay fever pollens

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[1] Paper from the Department of Botany and Plant Pathology, The Ohio State University No 514

[2] Data collected by the use of sticky coated microscope slides exposed to the atmosphere for a given period of time

[3] That is slides in no way sheltered

The purpose of the volumetric studies reported herein was to obtain a better understanding of the atmospheric concentrations of ragweed and oak pollens at Columbus, Ohio, as well as to check the feasibility of using Durham's conversion factors for volumetric incidence determinations in this area

VOLUMETRIC APPARATUS AND TECHNIQUE FOR COUNTING POLLENS

The volumetric apparatus (Fig 1) used in the following experiments was operated approximately 60 feet above the ground at the edge of the flat roof of the Botany and Zoology Building of The Ohio State University

By the passing of air through a glycerin-water-alcohol solution,[4] the pollen grains are trapped and the sampled air is metered Pyrex test tubes, 32 by 200 mm, hold the collection solution while others of the same size catch any of the solution escaping the collection tube Air enters the system through a three and one-half inch pyrex funnel which is connected to a three and one-half inch length of ⅝-inch diameter butyrate tubing The end of this tubing is perforated with 12 one-millimeter holes to break up the air stream Glass beads in the collection tube further break up the air stream and consequently result in a greater washing of the air

At the completion of each volumetric test, the complete collection unit was taken into the laboratory where the trap tube and funnel were washed with a small amount of water which in turn was added to the collection solution This solution was then removed from the collection tube The glass beads were washed several times with several milliliters of water, and the wash added to the collection solution which was then measured for total volume After removing the washed beads, the solution was replaced in the collection tube for storage until counts of the trapped pollen grains could be made

A Rafter Counting Cell, which holds one-milliliter of solution, was used to determine the approximate number of pollen grains collected during each test All counts were made with a 10X objective in conjunction with a 12 5 ocular In all instances at least three one-milliliter aliquots were observed for trapped pollen grains, and in cases where the first three counts were not approximately the same, additional counts were made until the average number of pollen grains per milliliter did not appreciably change In the determinations of oak pollen abundance, one drop of a saturated solution of basic fuchsin was added to the collection solution, approximately 40 ml, to facilitate counting In all cases the entire counting chamber was observed, and all of the pollen grains were counted

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[4] 60% glycerin, 30% water, and 10% ethyl alcohol

The efficiency of the apparatus to trap pollens was checked several times during the course of ragweed pollen sampling by placing a coated slide in the trap tube where it was adjacent to the entering washed air Following each test, Calberla's staining solution (11) was added to the slide, and the area covered by a 22 mm square cover slip was observed for pollen In every instance the observed area was found to be free of pollen The apparatus was further checked in the laboratory at the end of the ragweed season by directing a visible cloud of commercially dried ragweed pollen into the entry tube every 15 minutes over a period of two hours A coated slide was again placed in the trap tube Following the check the number of pollen grains in the collecting solution was approximately 150,000 while only eight were found on approximately five square centimeters of the check slide It was therefore concluded that, for all practical purposes, when the apparatus was operating properly it was essentially 100 per cent efficient

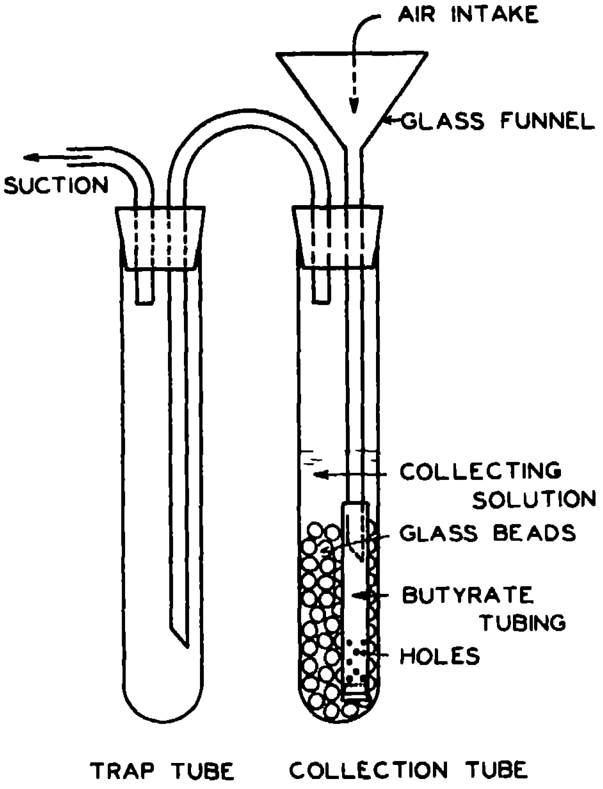

FIG 1 Pollen collection unit of the volumetric apparatus

VOLUMETRIC AND GRAVITY SLIDE STUDIES OF RAGWEED POLLEN DURING 1948

GRAVITY SLIDE STUDIES

Four standard gravity slide collectors were erected at various locations within the city prior to the 1948 ragweed pollen season One collector was located in the heart of the downtown business district on top of a six-story office building Two collectors were placed in residential districts, one being located approximately two miles east of the center of the city in a back yard of a densely populated area, while the other was located in a moderately populated and wooded district approximately six miles north of the central business district The fourth collector was located on top of the Botany and Zoology building at The Ohio State University Although the University district is only three miles north of the center of the city,

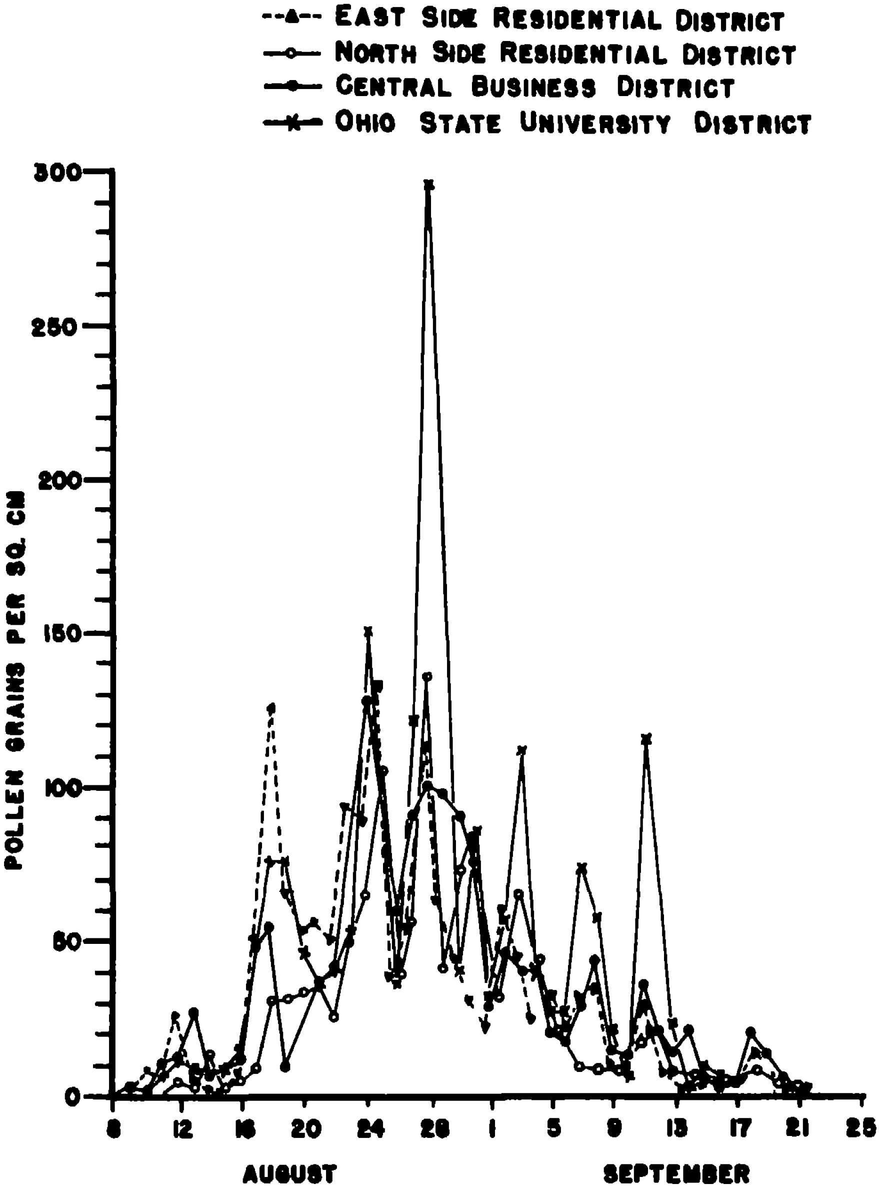

FIG 2 The 1948 ragweed pollen season as determined from data collected in standard gravity slide collectors

it is located near the city boundary, and open farming country lies immediately to the west and northwest All collectors were held approximately five feet above their respective bases by ¾-inch rod standards

Flowering of giant ragweed (*Ambrosia trifida*) occurred several days in advance of short ragweed (*A elatior*) and was first observed on August 5 Ragweed pollen was first collected by gravity slides on August 9, and by August 11 was being collected at each of the four stations Omitting daily variations, mainly due to climatic fluctuations, the resultant frequency curves of all the stations indicate that there was a daily increase in the number of air-borne ragweed pollen grains until the period of August 24 to 29, during which time maximum concentrations occurred There was then a rather steady decrease in the number of air-borne ragweed pollen, and by September 21 the daily catch at each station was less than five grains per square centimeter of gravity slide The curves of the downtown and two residential stations are essentially the same, the maximum collection at each of these stations being between 126 and 132 pollens per square centimeter (Fig 2)

The curve of the University station is similar to the curves of the other stations, but the daily collections are, in most instances, considerably greater This is probably due to the predominate westerly and relatively unobstructed air movements from adjacent farming and river areas where extensive stands of both tall and short ragweed occur As the velocities of these air movements are reduced by such obstructions as city buildings and vegetation, there is probably a dropping out of some of the pollen which results in lower collections at the stations other than the University station The greatest catch at the University station was 295 grains per square centimeter of gravity slide and occurred on August 28

The atmospheric ragweed pollen concentration, as it occurs over most of the city, can therefore be considered as a blanket of air in which the density of the ragweed pollen is essentially uniform Consequently, the data collected by a standard collector located well within the city proper can be used to represent the atmospheric incidence of this particular pollen, as it occurs over most of the city Data collected by a single collector during the tree and grass pollen seasons cannot be so used since the atmospheric abundance of these grains varies greatly between the downtown and northern residential districts

VOLUMETRIC STUDIES

Volumetric determinations were made during 29 consecutive days of the ragweed pollen season beginning on August 19 and ending on September 16, 1948 At the latter date the concentration of these pollen grains was less than 100 per cubic yard of air (Fig 3)

The weather during the greater part of the period of volumetric sampling was clear, hot to warm, and with little cloud formation or air movement The eight days prior to the date of maximum concentration, August 30, were all cloudless, hot, summer days during which the maximum temperatures recorded at the local Weather Bureau were, in most cases, high in the nineties The day of August 30 began as another hot, clear, quiet day, but by 10 a m thunderheads had developed, and at 12 o'clock a heavy thundershower commenced and continued for an hour This was the first precipitation in 12 days, and marked the end of the hottest and driest summer weather of the year A distinct daily fluctuation in the number of atmospheric ragweed pollen grains occurred during the first 10 days of sampling, days with a greater concentration of pollen being followed by days in which the concentration was markedly and proportionally less Since the meteorological conditions during the first 10 days of sampling were similar, the days being cloudless, dry, hot, and quiet, during which the temperature regimes were much the same, it is suggested that this daily fluctuation may be due to some inherent factor of the ragweed species

The maximum atmospheric concentration of ragweed pollen was slightly more than 10,000 grains per cubic yard of air, and occurred on the morning of August 30 immediately preceding the heavy thundershower mentioned above Field observations substantiated the fact that this peak concentration was largely due to the flowering of tall ragweed A second peak due to the flowering of short ragweed was expected but failed to materialize due to the dessication of the majority of the flowers during the hot, dry weather prevailing in the latter part of August

COMPARISON OF GRAVITY SLIDE AND VOLUMETRIC INCIDENCE DATA

Simultaneous gravity slide and volumetric incidence data were obtained during 29 consecutive days during the ragweed pollen season However, during the first 14 days of testing the writer failed to expose one set of gravity slides *only* during the volumetric sampling procedure Consequently, the gravity slide data for these days is of little comparative value On September 3 this error in procedure was corrected, and the following comparative data were obtained during the remainder of the season (Table I)

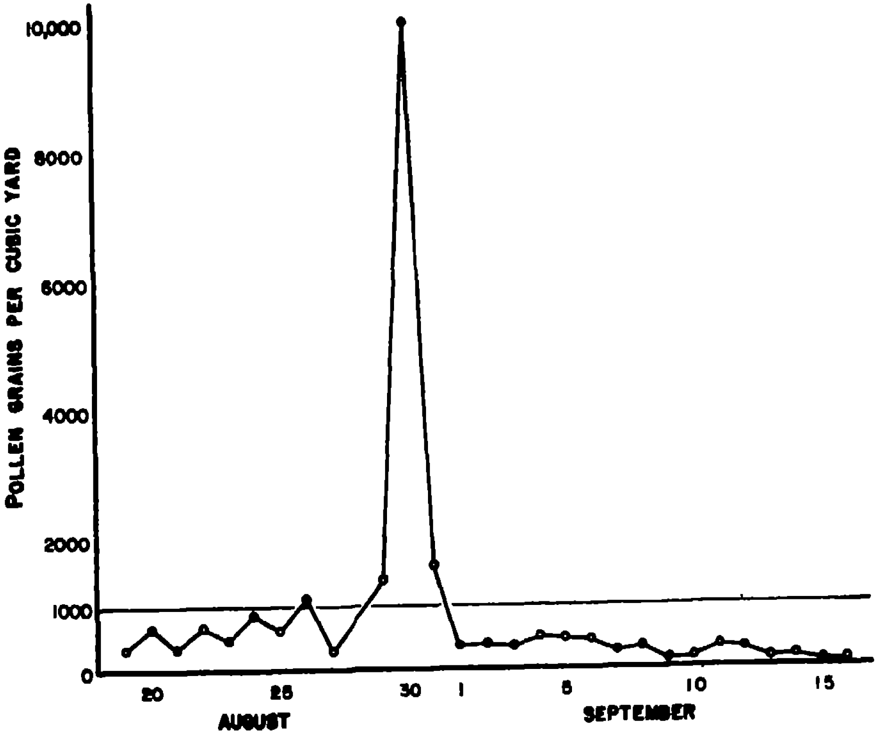

Fig 3 Volumetric incidence of ragweed pollen at Columbus, Ohio (1948)

The gravity slide and volumetric data can be compared in two ways, (A) by determining the ratio of the total pollens collected by each method during the 12 days of testing, or (B) by deriving the average daily ratio of the pollens collected by each method In this case the ratio of the total pollens collected by each method is 3 05, while the average daily ratio is 4 57 Durham used the ratio of the totals as the conversion factor, but in this instance the average daily ratio of 4 57 was found to give a more accurate conversion of the gravity slide data into equivalent volumetric units

The conversion factor for giant ragweed, as calculated by Durham, is 3 87, and was derived from the experimentally-determined conversion factor of 3 6 for

TABLE I

Calibration of Standard Sampling Device for Giant Ragweed Pollen

Date	Volumetric					Gravity Slide				Wind		Weather
	Vol of Air Sampled cu. ft	Pollen Grains per ml of Solution	Vol. of Solution ml	No of Pollen Grains Collected	No of Pollen Grains per cu yd of Air	Av No of Pollen Grains per sq cm	Duration of Tests Hrs	No of Grains Collected 24 Hr Basis	Ratio Vol / Gravity	Dir	Vel	
9/3	33.1	12.0	38.5	462.0	376.8	15.9	4.2	91.4	4.1	S	1-3	Clear in A M Cloudy in P M Warm
9/4	33.0	12.0	48.5	582.0	476.1	18.4	4.7	94.6	5.0	Var	0-1	Clear Hot
9/5	27.0	9.5	50.0	475.0	475.0	4.1	2.7	36.8	12.9	S E	4-7	Clear Hot
9/6	20.5	8.0	44.0	352.0	463.6	6.0	3.3	43.9	10.6	S E	4-7	Cloudy, Rain
9/7	30.0	6.0	51.5	309.0	278.1	42.9	4.2	246.2	1.1	S E	4-7	Heavy shower in A M
9/8	37.0	10.7	41.0	438.7	320.1	18.4	4.3	101.9	3.1	S W	1-3	Clear, Warm
9/9	33.0	4.0	47.5	190.0	155.4	6.4	3.5	44.1	3.5	N W	3-6	Overcast Cool
9/10	30.0	3.5	44.5	155.7	140.1	4.3	2.9	35.6	3.9	W	2-5	Clear Warm
9/11	43.0	12.5	42.0	525.0	329.6	50.7	4.7	260.1	1.3	S	4-7	Clear, Warm
9/12	33.0	11.3	33.5	378.5	309.7	24.5	3.8	155.6	2.0	S	1-3	Clear Warm
9/13	34.0	5.3	42.5	225.2	178.8	7.9	4.5	42.1	4.2	Var	0-1	Clear, Warm
9/15	30.0	3.3	31.5	103.9	93.5	3.7	2.9	30.4	3.1	Var	1-2	Clear Warm
Totals					3596.8			1182.7				
Ratio of Totals						3.04						
Average Daily Ratio								4.57				

short ragweed by taking into account the relative rates of fall between the two species In doing this, Durham assumed that the number of pollens falling, or impinging upon, a gravity slide are in proportion to their relative rates of fall Since the pollens of short ragweed were found to fall 0 93 times as fast as those of short ragweed, the conversion factor of 3 87 was obtained by dividing the conversion factor for short ragweed (3 6) by 0 93

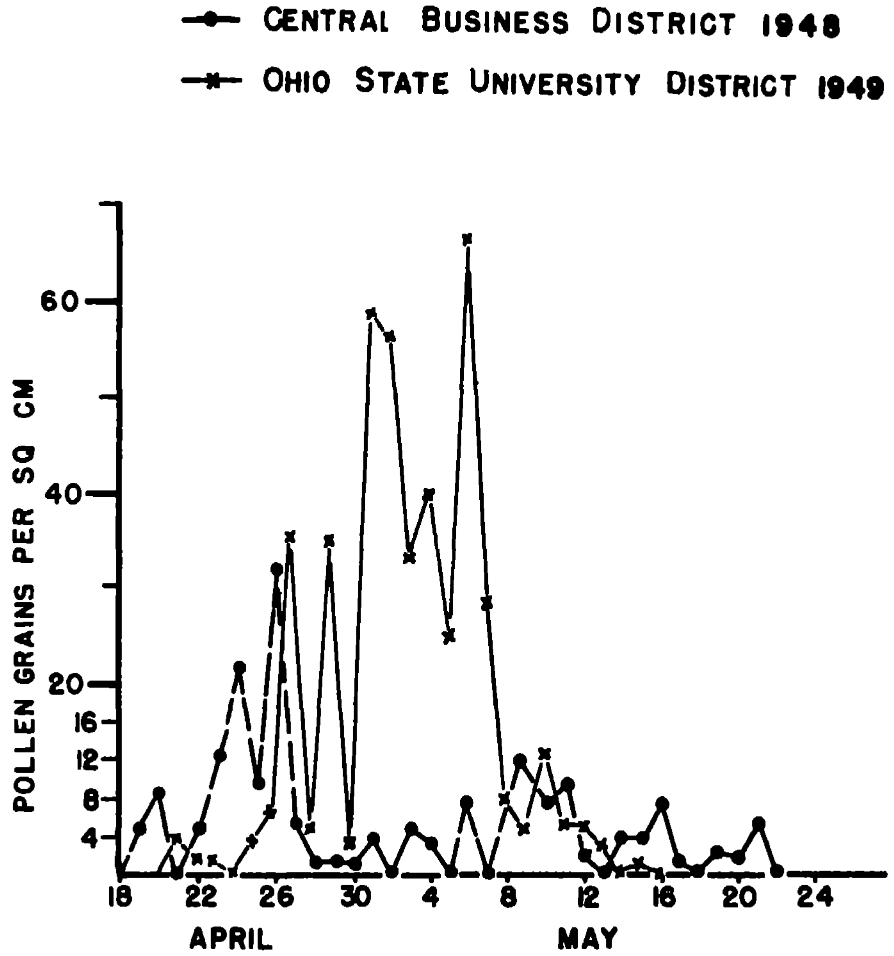

FIG 4 The 1948 and 1949 oak pollen seasons as determined from data collected in standard gravity slide collectors

This giant ragweed pollen conversion factor of 3 87 when corrected for the smaller size of these pollens in this area[5] is 4 68, and appears to compare favorably with the writer's experimentally determined factor of 4 57 It must be remembered that Durham's experimentally determined conversion factor for short ragweed is equal to the ratio of the total pollens collected by each method Using the average of the daily ratios, his adjusted factor for giant ragweed pollen in this area would be 4 96 However, this factor is also considered to compare favorably with the writer's experimentally determined factor It is therefore recommended that

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[5] The average diameter of giant ragweed pollen in this area is 17 51 μ

TABLE II

CALIBRATION OF STANDARD SAMPLING DEVICE FOR OAK POLLEN

	VOLUMETRIC					GRAVITY SLIDE				WIND		WEATHER
Date	Vol of Air Sampled cu ft	Pollen Grains per ml of Solution	Vol of Solution ml	No of Pollen Grains Collected	No of Pollen Grains per cu yd of Air	Av No of Pollen Grains per sq cm	Duration of Tests Hrs	No of Grains Collected 24 Hr Basis	Ratio Vol / Gravity	Dir	Vel	
5/2	153 5	2 28	41 0	93 71	16 48	6 19	10 5	14 16	1 16	W to S W	8-12	Clear Windy
5/3	156 0	2 33	35 0	81 55	14 11	5 57	10 7	12 51	1 13	N W	1-3	Clear Hot
5/4	144 0	6 00	31 0	186 00	34 87	10 33	10 0	24 79	1 41	S W	1-3	Clear Hot
5 5	123 0	6 00	33 0	198 00	43 46	6 40	9 0	17 07	2 55	N W	1-3	Clear Hot
5/6	115 0	4 75	37 0	175 75	41 26	19 63	7 2	65 31	0 63	N W	1-3	Clear Hot
5/10	165 5	2 66	40 5	107 73	17 57	9 09	10 5	20 62	0 85	N	8-12	Clear Cool High Overcast
Totals					160 82			154 47				
Ratio of Totals						1 04						
Average Daily Ratio									1 29			

the conversion factor of 4 57 be used in those years when tall ragweed pollen is predominate, and that Durham's conversion factor for short ragweed pollen, corrected for size difference, be used when short ragweed pollen is the dominant type

VOLUMETRIC AND GRAVITY SLIDE STUDIES OF OAK POLLEN DURING 1949

Locally, the most abundant oaks are white oak (*Quercus alba*), black oak (*Q velutina*), red oak (*Q rubra*), and pin oak (*Q palustris*) However, shingle oak (*Q imbricaria*), and burr oak (*Q macrocarpa*) are also present within the city limits, or in the surrounding territory, and are probably minor contributors to the oak pollen concentration

During three years of spring tree pollen sampling, pollens of the various oaks first appeared on gravity slides between April 16 and 21 Relatively high atmospheric concentrations during 1948, as determined from slides exposed at the downtown station, prevailed during the last week of April with a second minor peak occurring during the first three weeks of May The greatest catch was collected on April 26 and was 32 grains per square centimeter The 1949 season, as determined from slides exposed at the University station, began on April 21 and continued until May 11 with peak concentrations prevailing between April 25 and May 8 The greatest catch was collected on May 6 and was 67 grains per square centimeter (Fig 4)

The early peak in the 1948 spectrum was due to an unknown oak pollen which was collected only in small quantities during the 1949 season Since the 1948 peak occurred during days of relatively strong south winds, these unknown pollens probably originated in the southern portions of the state where chestnut oak (*Q muhlenbergii*), scarlet oak (*Q coccinea*), black oak and white oak occur in large numbers

Comparative data were obtained by volumetric and gravity tests during six days of the oak pollen season (Table II) There was a consistent daily correlation between the results of the two methods, the number of oak pollens per cubic yard of air being approximately 1 3 times greater than the number of pollens collected per square centimeter of gravity slide, consequently the factor of 1 3 is recommended as an oak pollen conversion factor in the Columbus, Ohio, area when the standard sampler is used Durham's calculated conversion factors for burr and shingle oak are 1 74 and 1 45 respectively These conversion factors are remarkably close to the writer's experimentally determined conversion factor for oak pollen in the Columbus area Since the pollen grains of all the oaks are very similar in size and configuration, this close agreement of the calculated and experimental conversion factors lends support to the accuracy of Durham's calculations for the determination of conversion factors for various important hay fever pollens by reference to their relative rates of fall as compared to that of short ragweed

SUMMARY

1 A new volumetric method for determining the atmospheric concentration of pollens is reported

2 Data from four standard gravity slide collectors, variously located within Columbus, Ohio, show that the atmospheric ragweed pollen concentration, as it occurs over most of the city is essentially uniform Consequently, the data from a standard collector located well within the city can be used to represent the incidence, of this particular pollen, as it occurs over most of the city Data from a single collector during the tree and grass pollen season cannot be so used since the atmospheric abundance of these grains varies greatly between the downtown and northern residential districts

3 Volumetric tests were made during 29 consecutive days of the 1949 ragweed season The volumetric incidence curve is included

4 From simultaneous gravity slide and volumetric tests, made during 12 days of the ragweed pollen season, it was found that the number of giant ragweed pollen grains per cubic yard of air averaged 4 57 times greater than the number collected per square centimeter of a gravity slide exposed in a standard collector Durham's calculated conversion factor for this pollen, when corrected for the smaller size of these grains in this area, is 4 96, and is considered to compare favorably with the writer's experimentally determined factor It is therefore recommended that a conversion factor of 4 57 be used in this area during those years when giant ragweed pollen is predominate, and that Durham's conversion factor for short ragweed, corrected for size difference, be used when short-ragweed pollen is the dominant type

5 The daily oak pollen concentrations during 1948 and 1949 are presented

6 Simultaneous gravity slide and volumetric tests during nine days of the 1948 oak pollen season indicate that the average number of oak pollen per cubic yard of air is 1 3 times greater than the number of pollen per square centimeter of a slide exposed in a standard collector

7 The close agreement between the writer's experimentally determined conversion factor for oak pollen in the Columbus, Ohio, area with Durham's calculated conversion factors for two species of oak lends support to the accuracy of Durham's calculations for the determination of conversion factors for various important hay fever pollens by reference to their relative rates of fall as compared to that of short ragweed

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NOTES ON THE DRAGONFLIES (ODONATA) OF NORTHWESTERN OHIO

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INTRODUCTION

Up until about ten years ago, when the writer first began collecting Odonata in northwestern Ohio, relatively little work had been done on the order in this section of the state This is an interesting section as certain northern and western species occur here which do not occur elsewhere in the state The Odonata collected by the writer in northwestern Ohio through 1942 are summarized by Montgomery (1943), this paper supplements Montgomery's list, and is based on six additional seasons of collecting, 1943 through 1948 These records cover the following northwestern counties Auglaize, Defiance, Fulton, Hancock, Henry, Mercer, Paulding, Putnam, Shelby, Van Wert and Williams

Montgomery's paper (1943) brought the list of Odonata recorded from Ohio to 133 species, five additional species are recorded in this paper, bringing the list to 138 These five species are ***Somatochlora ensigera***, ***Macromia wabashensis***, ***Gomphus* (*Stylurus*) *laurae***, ***Coenagrion resolutum***, and ***Gomphus externus*** Previously (Borror, 1937) there was some doubt as to the occurrence of ***Aeshna clepsydra*** in Ohio, the collection of 22 specimens of this species by the writer in Williams Co definitely establishes this species as occurring in the state

The writer is deeply indebted to Dr B Elwood Montgomery, of Purdue University, for making or checking the determinations of most of the species recorded in this paper, he is also indebted to Mrs L K Gloyd for checking the determinations of *G* (*S*) ***laurae*** The majority of the specimens collected by the writer are in the writer's collection but some specimens have been given to the Ohio State Museum collection in Columbus, the Experiment Station at Wooster, the U S National Museum, and the private collections of Dr B E Montgomery and Dr D J Borror

Most of the records in the list below are new county records Williams Co, with 74 species of Odonata, ranks second in the state in number of species (Franklin Co is first with 80 species), while Paulding Co with 70 species, is third A few sight records were made which would have represented new county records had the specimens been collected, these are ***Nasiaeschna pentacantha*** in Paulding Co, and N ***pentacantha***, ***Libellula incesta***, ***Epicordulia princeps***, ***Trapezostigma carolina***, and ***Pantala flavescens*** in Williams Co It seems very likely that with additional collecting Williams Co, the extreme northwestern county in Ohio, will equal or exceed every other Ohio county in the number of species of Odonata, it is conceivable that as many as 100 species may eventually be taken there

The localities at which the collections recorded in this paper were made are as follows

Auglaize Co —The State Fish Hatchery, near St Mary's

Defiance Co —Little (Krill's), Lehman's, and Ladd's Lakes, the Maumee and Auglaize Rivers, Lost, Lick, Bee Tree, and Eagle Creeks, and the Miami Extension Canal, southwest of Defiance, near the Paulding Co line Little Lake is a fairly good collecting area in some seasons

Fulton Co —Mill Creek, and Harrison Lake Harrison Lake is a newly created lake, formed by damming Mill Creek

Hancock Co —Haley's Pond (Blanchard Twp)

Henry Co —The Maumee River and the Miami Extension Canal

Mercer Co —Chickasaw Creek, the Wabash River, and Grand Reservoir (also called Celina Reservoir or Lake St Mary's)

Paulding Co —The Maumee, Auglaize, and Little Auglaize Rivers, the Flatrock, Blue, Six Mile, and Marie DeLarme creeks, the south loop of Gordon Creek, Bailey's gravel pit (Paulding Twp), Klinger's gravel pit (Jackson Twp), and old tile pond in Benton Twp , and a pool formed by an artesian well in Brown Twp , also various fields, woods, ditches, streams, etc The Maumee River, above the Forder Bridge, has a rather surprising odonate population for a stream so heavily polluted with sewage

Putnam Co —A large abandoned tile pond at Miller City, and the railroad reservoir at Continental

Shelby Co —The south shore of Lake Laramie, and woodland pools nearby

Van Wert Co —An abandoned stone quarry at Willshire

Williams Co —St Joseph's River, Fish, Bear, and Nettle Creeks, Mud and Nettle Lakes, two unnamed ponds, and two gravel pits Mud Lake is the most interesting of the lakes in this county, it is said to have been heavily dynamited by railroad laborers a number of years ago for its fish, and the present owner insists that it now contains very few fish Its bog meadow, with tamarack, poison sumac, shrubby cinquefoil, cranberry, several species of orchids, and fringed gentian, has a nice population of unusual Odonata, butterflies, and Orthoptera *Gomphus spicatus* fairly swarmed at this lake in June, 1948 Many afternoons were spent along Fish Creek east of Route 49, as well as at the St Joseph's River near its confluence with the creek, the gomphine population there is excellent Fish Creek is the outlet for Hamilton Lake (in Indiana)

On October 2, 1948, a special trip was made to Oxford, Ohio, to collect *Archilestes grandis* (Rambur) The weather was pleasantly cool The creek just south of Miami University, where the collecting was done, was dry except for occasional shallow pools The writer was there from 1 00 to 2.30 P M , and collected six males and two females All were easy to capture, and one pair in copulo was taken by hand Some eighteen or twenty other individuals were seen Some males had short abdomens Pairs were in copulo among the short willows, well up from the water No females were seen ovipositing, but Kennedy (in Needham and Heywood, 1929, p 269) states that *A californica* uses the stems of woody plants such as willows and alders for ovipositing, perhaps *A grandis* may do the same Only one male was seen hunting for prey This species has been recorded from this locality by Williamson (1930), Cotterman (1930), and Montgomery (1943)

LIST OF SPECIES

The species in the following list are numbered according to Borror's list (1937), and the records are given by counties Additional data are given for some species

2 *Gomphoides obscura* (Rambur) Defiance, Paulding, Williams. This species is rather common along Fish Creek in Williams County and Lost Creek in Defiance County, it was also taken along the south loop of Gordon Creek and the ripples in the Maumee River one-half mile west of the Forder Bridge in Paulding County

3 *Hagenius brevistylus* Selys Paulding, Williams. This species seems to be uncommon On August 1, 1946, at the St Joseph's River in Williams County, I saw a *Hagenius* capture a *Calopteryx maculatum* and carry it to a barbed wire fence nearby where it seemed to roll the body of its prey into a ball About five minutes later I tried to capture it but it boldly flew under the net and carried its prey to the upper branches of a tree where it was lost to view At this time it had not removed the wings of the *Calopteryx*

4 *Ophiogomphus rupinsulensis* (Walsh) Williams Several specimens were taken along the St Joseph's River

7a *Gomphus* (*Stylurus*) *amnicola* Walsh Paulding, Williams Several were collected along Fish Creek and the St Joseph's River in late August and early September One Paulding County specimen taken They were rather common at the ripples of the Maumee River west of the

Forder Bridge in Paulding County, a single male was secured on August 4, 1947 Four specimens were captured at the St Joseph's River in Williams County 1 ♀ 8/28/45, 1 ♂ 9/4/45, 1 ♀ 8/29/46, 1 ♀ 9/3/46

9 *Gomphus exilis* Selys Fulton, Williams Several were collected along Nettle Creek in Williams County, where it was rather common One specimen was taken at Mill Creek in Fulton County

138 *Gomphus externus* Hagen Paulding This species is an addition to the Ohio list Borror (1935) has shown that Kellicott's (1899) record of this species was really *Gomphus crassus* Seven males were taken at the ripples of the Maumee River west of the Forder Bridge on August 3, 4, 10, and 14, 1947 Nearly all were taken on boulders near the middle of the stream, where the width is about 260 feet, they were quite wary and it was necessary to move slowly to secure them One male was taken with prey, a Cabbage Butterfly (*Pieris rapae*) The weather was exceedingly hot, the days these specimens were collected

10 *Gomphus fraternus* (Say) Defiance, Paulding Williams Common, I have more specimens of this species in my collection than of any other *Gomphus*

11 *Gomphus furcifer* Hagen Defiance Collected at Little (Krill's) Lake, not nearly as common as *Gomphus spicatus*

12 *Gomphus graslinellus* Walsh Fulton, Mercer, Williams Common at the gravel pits and creeks but taken sparingly along the larger rivers

186 *Gomphus* (*Stylurus*) *laurae* Williamson Williams An addition to the Ohio list Previous captures have been recorded by Williamson (1932) for Indiana, Virginia, Georgia and South Carolina This species was collected near the confluence of Fish Creek and the St Joseph's River about one mile northeast of Edgerton, Ohio Most specimens were swept down from the foliage of trees overhanging the river or were taken as they flew by me over the shallow water by dropping the net over them quickly The following specimens were taken 1 ♂ 8/28/45 1 ♀ 9/21/45, 1 ♂ 8/1/46, 1 ♂ and 1 ♀ 9/3/46, 2 ♂ and 1 ♀ 9/5/46, 1 ♂ 9/8/46 No specimens were taken in 1947 or 1948 and it is believed that the colony may have been wiped out by too much collecting They are readily distinguished in flight from *Gomphus spiniceps* by the brighter color of the yellow on the last abdominal segments

14 *Gomphus lividus* Selys Williams Collected only at Nettle Creek near Nettle Lake Several specimens were taken

16 *Gomphus* (*Stylurus*) *plagiatus* Selys Paulding, Williams A single female was collected at Nettle Creek in Northwest Township, Williams County, on July 17 1947 One male was captured at ripples in the Maumee River in Paulding County west of the Forder Bridge on August 5 1947 This species had a very erratic flight on the Maumee, where its zigzag maneuvers distinguished it from the long straight sweeps of *Gomphus spiniceps* Many hours were spent in securing these two males

17 *Gomphus quadricolor* Walsh Williams Collected sparingly at Fish Creek

18 *Gomphus spicatus* Hagen Defiance, Williams Common at Ladd's and Little lakes in Defiance County and at Mud Lake in Williams County

19 *Gomphus* (*Stylurus*) *spiniceps* (Walsh) Paulding, Williams Only one specimen was taken at the ripples on the Maumee River in Paulding County Numerous specimens of this large trim species were taken from 1945 to 1948 at Fish Creek and the St Joseph's River in Williams County A few were taken in August, but the majority were taken in September Some were swept down from the foliage of trees overhanging the river, but more were taken by dropping the net over them suddenly as they approached me in their low flight over the rippling water Several were seen as they captured their prey and some were taken with prey, but by the time they were secured the prey was lost, often they plunged into the water after prey, and one was seen to plunge entirely under the surface. One habit repeatedly observed was that of dipping into the water two or three times in succession and then flying up to the higher branches of the trees The females oviposited much like the other species of *Gomphus* I have seen them ovipositing in early October and have taken this species later in the season than any other gomphine. Williamson's statement (1932), "A good series of *Stylurus spiniceps* has never been taken," will no longer apply as I have taken a series of more than 85 specimens and have at the present time 69 specimens in my collection Some specimens have a reddish bloom on the thorax, this may have been caused by cyanide Fresh specimens have a faint pinkish bloom on the

under side of the thorax but not on the sides or above Most specimens appear to have changed color but little in drying

20 *Gomphus vastus* Walsh Defiance, Paulding Common at the ripples on the Maumee River above the Forder Bridge.

21 *Gomphus ventricosus* Walsh Defiance, Williams. Numerous specimens were collected along Fish Creek and the St Joseph's River in 1946

25 *Dromogomphus spoliatus* (Hagen) Henry Kellicott's statement "Common in northwestern Ohio along the Maumee River and its tributaries and the Ohio Canal' (1899, p 73), still holds true in part I have found it common along the Auglaize River but have failed to observe it along the St Joseph's River In August 1945 I captured a male *Macromia taeniolata* a few seconds after it had been knocked into the water by one of these insects It is easily taken at times and very wary at other times It is a very interesting species. Many specimens were taken

28 *Basiaeschna janata* (Say) Williams A single specimen was taken near Mud Lake on May 5, 1948

30 *Boyeria vinosa* (Say) Auglaize, Defiance Paulding, Williams. I have spent afternoons in September along the St Joseph's River at the mouth of Fish Creek when one or more of this species would be in sight almost constantly It is fairly common along Lost Creek in Defiance County, and is uncommon or rare in Paulding County where only one specimen has yet been captured On September 8, 1945, at Fish Creek I collected 3 males and let 5 escape in a period of 15 minutes (timed) The streams of Paulding County seem to be too muddy and sluggish for this species. I captured two specimens with their prey (*Hetaerina americana*) and saw them carry away this species on numerous occasions One was once seen feeding on a *Calopteryx maculatum*

31 *Anax junius* (Drury) Defiance Fulton, Henry, Williams

33 *Nasiaeschna pentacantha* (Rambur) Defiance A male and female were collected along the Miami Extension Canal southwest of Defiance Difficult to take This species was seen (but not collected) in Paulding and Williams Counties

34 *Epiaeschna heros* (Fabricius) Defiance, Williams At various times in May and early June, females have been seen ovipositing in rotten logs and bits of wood lying in water in a swampy woods along the Miami Extension Canal in Defiance County One was observed at different times to alight on a large rusty metal container and try to oviposit One alighted on my wet boots and tried to oviposit They were also seen ovipositing on the trunks of small trees well above the water line as well as in mud Five were seen at one time, all ovipositing near each other on a small badly rotted log This species was very common in 1943 it has not been so plentiful since These giant darners were fairly common along a slough of Flatrock Creek in Paulding County in June 1948 I captured only one, and couldn't help noticing how inconspicuous they were when they flew up from the ground, practically at my feet One who was not interested in Odonata probably would not have noticed them

35 *Aeshna clepsydra* Say Williams A total of 20 ♂ and 2 ♀ were taken at Mud Lake 3 ♂ and 1 ♀ 8/22/48, 2 ♂ 8/24/48 8 ♂ 9/3/48, 4 ♂ 9/16/48, 3 ♂ and 1 ♀ 10/1/48 This species was partial to a bed of yellow water lilies and pickerel weed on the east side of the lake Both females were captured there, one while ovipositing and the other just after a male had seized her The female taken on October 1 was very dark (almost entirely brown) The color pattern on the side of the thorax was faint but similar to that of all others collected She was ovipositing by extending her abdomen into mud and water while perched on a fallen plant Another female (not collected) was observed on an earlier date ovipositing in a small knob of wet mud projecting out of the water, there were no plants of any kind on the knob The males have a faded blue appearance in flight, much lighter than *A constricta* or *A mutata* One was seen about 10 feet up on a tree trunk, but none were flushed from weeds or shrubs as was the case with *A mutata* in June.

36 *Aeshna constricta* Say Defiance, Mercer, Williams More than 70 specimens of this species were taken in 1943 Most of them were taken at a slough of Flatrock Creek in Benton Township, Paulding County sweet flag (*Calamus*) was abundant there and the females oviposited in its tissues The males seemed to be looking for females The majority were taken in September Some were taken on chilly days

37 *Aeshna mutata* Hagen Williams Rather common at Mud Lake in June 1948 A single male was taken on July 4, by that time they had nearly disappeared The blue face and compound eyes add to the beauty of this species

38 *Aeshna umbrosa* Walker Auglaize, Defiance, Fulton Paulding, Williams Probably less common in Paulding County than any of the above named counties

39 *Aeshna verticalis* Hagen Mercer, Paulding Williams Not nearly as common as *A constricta*

44 *Macromia illinoiensis* Walsh Paulding, Williams Many specimens were taken at the ripples in the Maumee River above the Forder Bridge the species was not observed in numbers elsewhere I find this a difficult species to see in flight Most specimens have been collected in the first half of August

128 *Macromia pacifica* Hagen Paulding One female was taken along Flatrock Creek in Benton Township on August 14, 1943 The silky sheen of the alternating bands of golden yellow and rich brown on the abdomen make this a beautiful species in life

45 *Macromia taeniolata* Rambur Paulding Kellicott's observation, "Common in the northwestern part of the state along the Maumee River (1899 p 87) still holds true I have observed and collected it most commonly at favored places along the Auglaize River and its lagoons Thus far I have not seen it along the St Joseph's River Its habit of remaining in trees on some days makes it appear scarce when the opposite is true I have collected as many as 20 specimens in an afternoon It is a large and beautiful insect that is not too easy to collect

135 *Macromia wabashensis* Williamson Defiance This species is an addition to the Ohio list It has previously been recorded only from Wells County, Indiana A single male was taken June 17 1944, at the Miami Extension Canal southwest of Defiance near the Paulding County line The costa of the wings is yellow to the tip and the wings are largely flavescent

49 *Epicordulia princeps* (Hagen) Defiance, Paulding (not collected) Observed at Ladd s and Little lakes in Defiance County, and at Klinger s Gravel Pit in Paulding County Four beautiful specimens were taken in one afternoon at Little Lake in 1947 In my opinion this species is one of our most beautiful insects

50 *Tetragoneuria cynosura* (Say) Defiance, Paulding, Williams I have not seen this species as abundant in Ohio as at some of the Indiana lakes, where it virtually swarms in some seasons

134 *Somatochlora ensigera* Martin Paulding A new state record On June 20, 1943 a female was taken along a dirt road about 40 rods from a ditch in Benton Township All specimens since have been taken along ditches at some distance from woods On July 9, 1948, 8 ♂ and 1 ♀ were taken from 5·00 to 6·00 P M along a ditch near my home A female was taken from this ditch on August 16, 1947, she was easily taken by hand while she was hovering and ovipositing in about one-half inch of water She was nearly concealed from above by grasses and sedges that arched over the narrow trench at the bottom of the ditch I have found the female of *S linearis* difficult to take with a large net while in the act of ovipositing its erratic flight in deep shade contrasts sharply with the hovering flight of *S ensigera* in sunlight

133 *Somatochlora linearis* (Hagen) Defiance. Most of the 60 specimens at hand (57 ♂ and 3 ♀) were taken in Paulding County along little streams flowing through woods, these streams were well shaded and were dry except for occasional pools By walking slowly in the bed of the stream and watching carefully, one can sweep some specimens from roots or dead branches overhanging the stream The middle of August is an excellent time to collect them in this region This species is probably more plentiful in Ohio than is generally believed

54 *Perithemis tenera* (Say) Defiance, Putnam, Williams On August 24, 1948, a pair was seen in copulo on a leaf of the yellow water lily at Nettle Lake in Williams County Still in copulo, they flew down to the water where the male released the female but fluttered attentively near while she oviposited like a *Libellula* after two or three minutes they coupled and flew up to the leaf of another lily This procedure was repeated twice while I was about 10 feet away Williamson states (1932, p 36), "It remains for some sympathetic observer to record the sexual antics of *P tenera*, the act of oviposition "

55 *Celithemis elisa* (Hagen) Defiance, Paulding, Putnam, Williams

56 *Celithemis eponina* (Drury) Defiance, Henry, Paulding, Putnam, Williams

57 *Celithemis monomelaena* Williamson Williams Two specimens were taken at Mud Lake, in 1947 and 1948

60 *Ladona julia* (Uhler) Williams A good series (58 specimens) was taken from May 23 to June 30 1948, at Mud Lake They were abundant and easily taken The height of their abundance seemed to be about May 30 On June 30 only one was seen

62 *Libellula* (*Holotania*) *cyanea* Fabricius Defiance, Williams Common at Little Lake in 1945 uncommon or rare since then Common at Mud Lake in 1947 and 1948

63 *Libellula* (*Holotania*) *incesta* Hagen Defiance, Williams (seen not collected) Common at Little Lake in 1945, uncommon since

64 *Libellula* (*Holotania*) *luctuosa* Burmeister Defiance Putnam

65 *Libellula* (*Plathemis*) *lydia* Drury Hancock, Putnam

66 *Libellula* (*Neotetrum*) *pulchella* Drury Henry, Hancock, Paulding

68 *Libellula* (*Eolibellula*) *semifasciata* Burmeister Defiance, Van Wert, Williams

69 *Libellula* (*Holotania*) *vibrans* Fabricius Defiance, Paulding This species was observed in numbers at woodland pools in Paulding County and at swampy woods beside the Miami Extension Canal in Defiance County in 1943, numerous beautiful specimens taken It is easily taken on some days and very hard to secure at other times Several females were noted ovipositing by dipping the tip of the abdomen in water in the shade while one or more males fluttered above Only one specimen has been taken since 1943 I have yet to see this species at a lake woodland pools and swampy places seem to be its habitat

70 *Sympetrum ambiguum* (Rambur) Defiance Henry Mercer Many specimens were taken of this green faced species

71 *Sympetrum corruptum* (Hagen) Paulding This species, the largest of our Sympetrums was taken at artificial ponds Several were taken in late July and early August at a waste pool of the Paulding Sugar Company at Paulding It was taken sparingly at a large abandoned tile pond at Miller City in Putnam County It is far more wary than our other Sympetrums Some specimens looked like *Pantala flavescens* while flying

72 *Sympetrum obtrusum* (Hagen) Defiance, Henry, Mercer, Paulding

73 *Sympetrum rubicundulum* (Say) Henry, Hancock, Van Wert

74 *Sympetrum semicinctum* (Say) Defiance, Paulding All specimens from Defiance County were taken at a slough of Lost Creek on the Bricker Stock Farm northeast of Hicksville Several were taken in 1948 at a pool formed by an artesian well in Brown Township, Paulding County This pool has already been ruined by drainage

76 *Sympetrum vicinum* (Hagen) Defiance, Putnam Williams

77 *Leucorrhinia intacta* (Hagen) Defiance, Fulton Hancock, Paulding, Williams

78 *Pachydiplax longipennis* (Burmeister) Fulton, Hancock, Putnam, Williams

79 *Erythemis simplicicollis* (Say) Defiance, Hancock, Paulding, Putnam

80 *Pantala flavescens* (Fabricius) Paulding, Williams (seen, not collected) Difficult to capture

81 *Pantala hymenaea* (Say) This species tires quickly in a stiff breeze Many specimens were collected in Paulding County in 1948

82 *Trapezostigma carolina* (Linnaeus) Williams (seen, not collected)

83 *Trapezostigma lacerata* (Hagen) Defiance, Hancock, Putnam, Williams Common

84 *Trapezostigma onusta* (Hagen) Paulding Two males and one female were taken on July 23 1948, at a waste pool of the Paulding Sugar Company at Paulding The basal fourth of the hind wings was brown, the hamules of the males were much longer than the genital lobes The vulvar lamina of the female was bilobed for the entire length All were somewhat teneral otherwise I probably would not have been able to capture them

85 *Calopteryx aequabilis* Say Williams Three males were captured and one teneral seen at Nettle Creek on June 8, 1948 A few days later another search was made for them at the same station but none were seen.

87 *Calopteryx maculatum* (Beauvais) Defiance, Fulton This species is usually rather common along Fish Creek in Williams County in early September, after it has disappeared elsewhere in this area.

88 *Hetaerina americana* (Fabricius) Defiance, Fulton, Henry, Mercer, Williams

89 *Hetaerina titia* (Drury) Williams Common in September at Fish Creek On September 8, 1945, a female was observed for perhaps thirty seconds while she crawled and oviposited on a board about two inches under water at Fish Creek In September, 1946, a male and female in tandem alighted on a rotten stump in the St Joseph's River near me The female began backing down into the water, and when the tip of the abdomen of the male touched the water he released her, she then disappeared from sight Several minutes later I rolled the stump over and found the female still ovipositing in the stump about four inches under water

91 *Lestes congener* Hagen Paulding, Williams Fairly common in autumn

92 *Lestes disjunctus* Selys Several males were taken at a slough of Flatrock Creek in Benton Township, Paulding County on April 21, 1946

94 *Lestes forcipatus* Rambur Defiance, Paulding Williams

95 *Lestes inaequalis* Walsh Defiance Williams Taken in small numbers at Little Lake in Defiance County and at Mud Lake in Williams County

96 *Lestes rectangularis* Say Defiance, Hancock, Henry

97 *Lestes dryas* Kirby Defiance Hancock, Shelby

98 *Lestes unguiculatus* Hagen Defiance Henry, Mercer, Williams

99 *Lestes vigilax* Hagen Williams Several specimens were taken at Mud Lake in 1948

100 *Argia apicalis* (Say) Henry, Williams

102 *Argia moesta* (Hagen) Fulton, Henry, Mercer Paulding

103 *Argia sedula* (Hagen) Auglaize, Defiance, Paulding Van Wert, Williams Taken in small numbers, usually but one specimen a day

104 *Argia tibialis* (Rambur) Defiance Fulton, Paulding, Van Wert

105 *Argia violacea* (Hagen) Defiance, Fulton

108 *Nehalennia irene* (Hagen) Paulding, Williams

137 *Coenagrion resolutum* (Hagen) Paulding A new state record A single male was taken in Benton Township at a slough of Flatrock Creek on July 16 1945

109 *Chromagrion conditum* (Hagen) Fulton Paulding Williams

110 *Enallagma antennatum* (Say) Fulton, Henry Putnam Van Wert Williams

111 *Enallagma aspersum* (Hagen) Defiance Williams

112 *Enallagma boreale* Selys Defiance, Williams Four males of this species were collected 1 ♂ Miami Extension Canal (Defiance Co), 6/19/46, 1 ♂ 5/28/48 and 2 ♂ 5/30/48, Mud Lake (Williams Co)

129 *Enallagma basidens* Calvert Defiance, Putnam Van Wert, Williams Well distributed over this area especially at gravel pits

114 *Enallagma civile* (Hagen) Auglaize, Henry Mercer Putnam Williams

117 *Enallagma ebrium* (Hagen) Defiance, Henry, Williams

118 *Enallagma exsulans* (Hagen) Fulton Henry, Mercer Williams

119 *Enallagma geminatum* Kellicott Defiance Williams

120 *Enallagma hageni* (Walsh) Paulding, Williams

121 *Enallagma signatum* (Hagen) Defiance, Mercer, Putnam

122 *Enallagma traviatum* Selys Defiance, Williams

123 *Enallagma vesperum* Calvert Defiance Williams Abundant at Little Lake Defiance County, in late afternoons in the summer of 1945 Scarce at Mud Lake in Williams County in 1948

124 *Ischnura posita* (Hagen) Defiance, Putnam Williams

126 *Ischnura verticalis* (Say) Fulton, Hancock, Putnam, Williams

127 *Anomalagrion hastatum* (Say) Paulding

The collections of the writer in northwestern Ohio have extended the seasonal range of many species in the state The new late dates are given below (the species are numbered as in the preceding list)

2 *Gomphoides obscura* (Rambur) Sept 1, 1945

3 *Hagenius brevistylus* Selys Sept 1, 1945

7 *Gomphus (Stylurus) amnicola* Walsh Sept 3, 1946

10 *Gomphus fraternus* (Say) Aug 10, 1947

11 *Gomphus furcifer* Hagen July 8, 1945

12 *Gomphus graslinellus* Walsh Aug 5, 1943
16 *Gomphus* (*Stylurus*) *plagiatus* Selys. Aug 5, 1947
19 *Gomphus* (*Stylurus*) *spiniceps* (Walsh) Oct 7, 1945
21 *Gomphus ventricosus* Walsh July 12, 1946
25 *Dromogomphus spoliatus* (Hagen) Sept 27, 1945
30 *Boyeria vinosa* (Say) Oct 1, 1944
33 *Nasiaeschna pentacantha* (Rambur) July 8, 1943
36 *Aeshna constricta* Say Oct 10, 1943
44 *Macromia illinoiensis* Walsh Sept 4, 1945
128 *Macromia pacifica* Hagen Aug 14, 1943
45 *Macromia taeniolata* Rambur Sept 1, 1945
133 *Somatochlora linearis* (Hagen) Aug 24, 1945
64 *Libellula* (*Holotania*) *luctuosa* Burmeister Sept. 21, 1945
65 *Libellula* (*Plathemis*) *lydia* Drury Sept 18, 1942
66 *Libellula* (*Neotetrum*) *pulchella* Drury Sept 5, 1943
68 *Libellula* (*Eolibellula*) *semifasciata* Burmeister Aug 9, 1943
69 *Libellula* (*Holotania*) *vibrans* Fabricius. Sept 10 1943
72 *Sympetrum obtrusum* (Hagen) Sept 27, 1945
73 *Sympetrum rubicundulum* (Say) Oct 7, 1945
76 *Sympetrum vicinum* (Hagen) Nov 18, 1945
87 *Calopteryx maculatum* (Beauvais) Sept 21 1945
88 *Hetaerina americana* (Fabricius) Oct 18 1944
89 *Hetaerina titia* (Drury) Oct 1, 1944
91 *Lestes congener* Hagen Nov 1, 1944
94 *Lestes forcipatus* Rambur Sept 15, 1943
96 *Lestes rectangularis* Say Oct 10, 1945
98 *Lestes unguiculatus* Hagen Sept. 28, 1943
100 *Argia apicalis* (Say) Oct 1, 1944
102 *Argia moesta* (Hagen) Oct 1, 1944
104 *Argia tibialis* (Rambur) Sept 27, 1945
105 *Argia violacea* (Hagen) Sept 21, 1945
129 *Enallagma basidens* Calvert Sept 21, 1945
127 *Anomalagrion hastatum* (Say) Sept 3, 1944

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DID YOU KNOW?

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PERMEABILITY—A PRIME FACTOR IN EXTRACTION OF CHLOROPLAST PIGMENTS

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The extraction of chloroplast pigment from dried nettle leaves is accomplished best in 80–90% aqueous acetone, in 90% aqueous ethanol and in absolute methanol (Willstätter and Stoll, 1913) Just why 80–90% aqueous acetone is better than anhydrous acetone, why 90% aqueous ethanol is better than absolute ethanol, and why absolute methanol is better than any of its aqueous dilutions has never been satisfactorily explained Willstätter and Stoll (1913, p 57) explained it on the basis that "water added to the organic solvents dissolves mineral salts, as for example, potassium nitrate, from the leaf substance," and that "salt solution that is formed changes the colloidal state of the chlorophyll in the chloroplasts and makes it easily soluble "

MATERIALS AND METHODS

To study the permeability of plant tissues to various organic solvents, seeds of sweet corn, soybean, and garden pea were used The sweet corn was Burpee's Golden Bantam, the soybeans were of the Lincoln variety locally acquired, and the garden pea seeds were Burpee's Blue Bantam (wrinkled) The seeds were soaked in organic solvents at room temperature (25–30° C), and weighings of the superficially dried seeds were taken at the end of 1 day, 4 days, and 7 days The organic solvents were methanol, ethanol, and acetone Methanol was dehydrated with magnesium turnings which forms magnesium methoxide, then refluxed and distilled Ethanol was dried over Drierite and then with metallic sodium which forms sodium ethoxide, then refluxed and distilled Acetone was dried merely over Drierite, then refluxed and distilled The aqueous dilutions of methanol, ethanol, and acetone were made on the basis of volume

Changes in the lengths of soybean seeds soaking in absolute, 95%, 90%, and 85% methanol were determined by use of a vernier calipers Specific gravity for some of the solutions was determined by use of a specific gravity bottle

A Klett Biocolorimeter was used to determine the relative amounts of chloroplast pigments extractable by acetone-water solvent to which $NaNO_3$ and cane sugar, respectively, had been added as compared to the amounts of chlorophyll pigments extractable by acetone-water solvent alone The amount of pigments extractable by 85% acetone was used as the standard for comparison It was given an arbitrary value of 100 and all the others were evaluated comparatively by colorimetric measurements

EXPERIMENTAL RESULTS

Seeds of sweet corn, soybean and wrinkled garden pea soaked in absolute methanol, absolute ethanol, and anhydrous acetone showed a remarkably greater imbibition of absolute methanol during the first day than of absolute ethanol or of anhydrous acetone (Tables I and III) To be specific, soybean seeds absorbed or imbibed absolute methanol equal to 7 7% of their dry weight during the first day, whereas they imbibed absolute ethanol equal to only 1 6% of their dry weight in the same period of time, and anhydrous acetone equal to only 0 1% of their dry weight This difference is more pronounced at the end of 4 days and at the end of 7 days The soybean seeds in absolute methanol also showed a distinct increase in

TABLE I

INCREASE IN WEIGHT OF 100 SOYBEAN SEEDS SOAKED IN VARIOUS ORGANIC SOLVENTS

Solvent in Days	Weights in Grams	Per Cent Increase
Absolute methanol (100%)		
0	12 95	
1	13 95	7 7
4	14 30	10 4
7	14 59	12 7
Absolute ethanol (100%)		
0	14 94	
1	15 50	1 6
4	15 65	2 6
7	15 77	3 4
Anhydrous acetone (100%)		
0	13 17	
1	13 18	0 1
4	13 31	1 1
7	13 47	2 3

TABLE II

INCREASE IN LENGTH OF SOYBEAN SEEDS SOAKED IN WATER FREE SOLVENTS DATA ARE AVERAGES OF 10 SEEDS ABSOLUTE INITIAL AVERAGE LENGTHS ARE GIVEN IN PARENTHESES

Days Soaked	Absolute Methanol (725 cm)	Absolute Ethanol (742 cm)	Anhydrous Acetone (718 cm)
1	036 cm	010 cm	003 cm
4	061 cm	020 cm	020 cm
7		031 cm	031 cm
14	091 cm	039 cm	041 cm

TABLE III

INCREASE IN WEIGHT OF 50 SEEDS OF WRINKLED PEA AND OF 50 SEEDS OF SWEET CORN SOAKED IN VARIOUS ORGANIC SOLVENTS

SOLVENT IN DAYS	WRINKLED PEA		SWEET CORN	
	Weight in Grams	Per Cent Increase	Weight in Grams	Per Cent Increase
Absolute methanol (100%)				
0	14 30		12 61	
1	15 76	10 2	13 72	8 8
4	16 73	17 0	14 24	12 9
7	17 38	21 5	14 55	15 4
Absolute ethanol (100%)				
0	14 69		13 92	
1	14 89	1 4	14 16	1 7
4	15 42	5 0	14 18	1 9
7	15 83	7 8	14 25	2 4
Anhydrous acetone (100%)				
0	13 03		13 46	
1	13 03	0	13 61	1 1
4	13 00	0	13 59	1 0
7	13 00	0	13 60	1 0

length in contrast to very little change in the length of seeds soaked in absolute ethanol and anhydrous acetone (Table II)

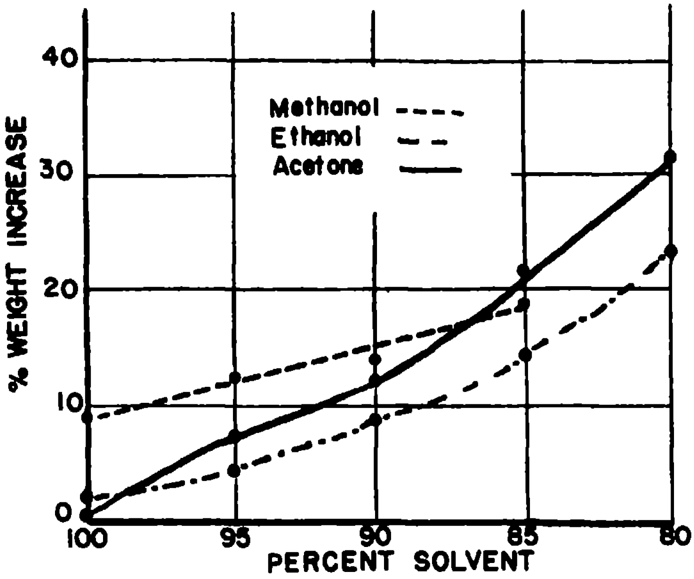

Fig 1 Per cent increase in weight of sweet corn seeds soaked in various aqueous dilutions of methanol ethanol, and acetone for one day

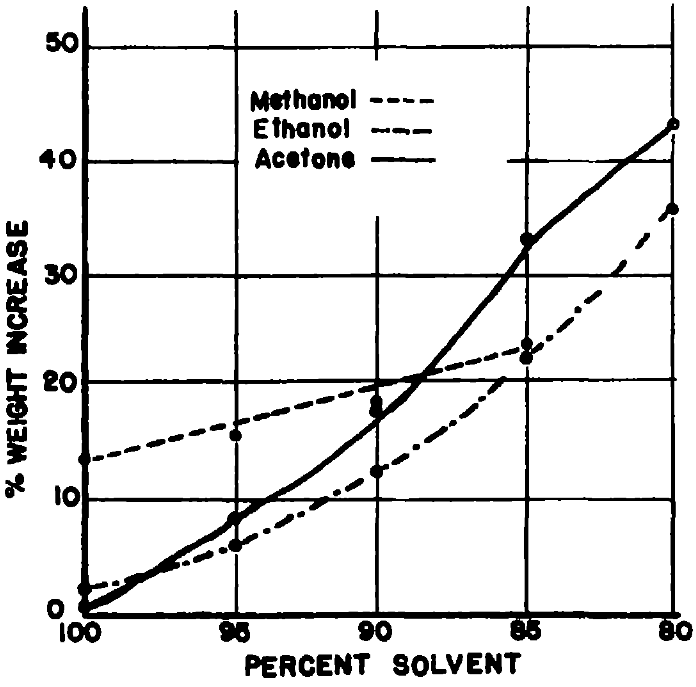

Fig 2 Per cent increase in weight of sweet corn seeds soaked in various aqueous dilutions of methanol ethanol, and acetone for four days

Seeds in absolute methanol get to be quite soft and can be sectioned very easily with a razor blade This is not true for seeds soaked in absolute ethanol or in anhydrous acetone which only permeates slightly and produces little change in the original hardness of the seeds The data for sweet corn seeds and for wrinkled pea seeds (Table III) are even more diverse in the differences Permeability in various aqueous dilutions of methanol, ethanol, and acetone can best be described by the graphic illustrations of Figures 1–3 The points for methanol form an approximate straight line which has about the same slope in the 1-day, 4-day, and 7-day periods The points on the graph for ethanol and for acetone form curves which have distinctly greater slopes than the line for methanol Of the curves for ethanol and for acetone, the curve for acetone has the greater slope, and the slope for the 4 days is greater than for one day and greater for 7 days than for 4 days This means that dilutions of these three organic solvents with water produce the greatest change in imbibition with acetone, and least with methanol The result is that all of these lines intersect Whereas 100% methanol is imbibed far more abundantly than either 100% ethanol or 100% acetone, 85% acetone is imbibed more than either 85% ethanol or 85% methanol All of the graphs show this tendency for greater increase in absorption of acetone with greater aqueous dilutions and for a rather uniform increase in absorption of methanol with greater aqueous dilutions Ethanol is intermediate between methanol and acetone

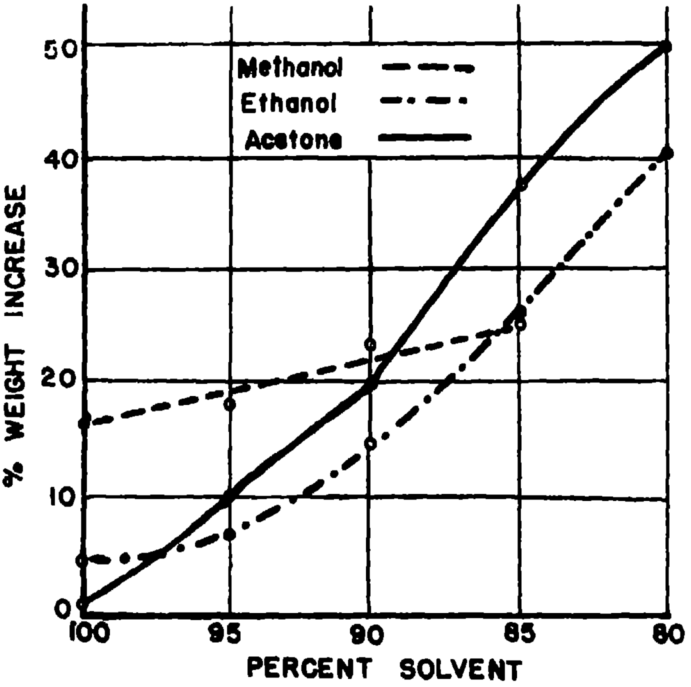

FIG 3 Per cent increase in weight of sweet corn seeds soaked in various aqueous dilutions of methanol, ethanol, and acetone for seven days

The specific gravity determinations presented in Table IV show very little difference in values at the start as compared to the end of an imbibitional period This seems to indicate that there is very little or no differential or preferential absorption of either the organic solvent or the water which dilutes the organic solvent

Sugar and Salt Effect—That penetrability of solvent is a prime factor in the extraction of chloroplast pigments is further substantiated by the effect of salts and sugars Sodium nitrate decisively increases the amount of chloroplast pigments extracted from dry nettle leaf powder in one hour by 80% acetone, and cane sugar decreases the amount of chloroplast pigments extractable in one hour (Table V) Quantities used in each case were 1 g of dried nettle leaves, 20 ml of acetone solvent, 1 g $NaNO_3$ and 5 g of cane sugar Values are those obtained by comparing the extract colorimetrically with the extract in 85% acetone which was used as the standard and arbitrarily given the value of 100

A corresponding effect is registered by the sodium nitrate and the cane sugar on the initial rate at which seeds imbibe 80% acetone The data are given in Table VI

TABLE IV

SPECIFIC GRAVITY CHANGES IN SOLVENTS DURING A 21 DAY SOAKING PROCESS

SOLVENT	SEEDS	SPECIFIC GRAVITY	
		Beginning	End
Acetone, 100%	Wrinkled pea	790	780
95%	" "	807	807
80%	" "	826	822
100%	Sweet corn	700	702
95%	" "	807	811
90%	" "	826	827
80%	" "	862	868
Methanol, 100%	Sweet corn	793	800
95%	" "	811	819
90%	" "	827	829
85%	" "	843	838
Ethanol, 100%	Sweet corn	795	801
95%	" "	809	811
90%	" "	827	829

Sodium nitrate and cane sugar have another effect, also This effect is on the solubility of chloroplast pigments The effect is, however, slight (about 6–9%) and in the direction of decreased solubility The greatest influence of the salt and the sugar on extractability of chloroplast pigments must be accredited to their effect on the permeability of the plant material to the solvent

DISCUSSION

The extraction curves of Willstätter (1915) as presented in Figure 4 can be explained by a joint consideration of chloroplast pigment solubility and of the relative permeability of plant tissues to these solvents and their aqueous dilutions Chlorophyll pigments are always more soluble in water-free fat solvents and become less and less soluble as the water content increases Although chloroplast pigments are more soluble in anhydrous acetone than in 80% acetone, the dominant influence in extraction is the very low permeability of dry leaf powder to anhydrous acetone and its extremely high permeability to acetone containing 20% water

Dry plant tissues are extremely permeable to methanol The permeability to absolute methanol is high, and the permeability increases only slowly to mixtures of water and methanol Chloroplast pigment solubility in methanol decreases rather rapidly as the water content increases With acetone the chloroplast pigment solubility does not drop nearly as rapidly with an increase in water content (Eyster, unpublished data) Since extraction of chloroplast pigments seems to be due to a combined joint influence of solubility and tissue permeability, this perhaps is adequate to account for the fact that extraction of chloroplast pigments is always greatest in absolute methanol and decreases in dilutions of methanol with water

TABLE V

EXTRACTABILITY OF CHLOROPLAST PIGMENTS FROM DRIED NETTLE LEAVES IN ONE HOUR AT ROOM TEMPERATURE AS AFFECTED BY $NaNO_3$ AND CANE SUGAR THE DATA ARE ONLY COMPARATIVE VALUES AND WERE OBTAINED BY COLORIMETRICALLY COMPARING THE FILTERED SOLUTIONS WITH THE 85% ACETONE FILTRATE VALUED ARBITRARILY AT 100

Solvent Per Cent	Acetone	Acetone + $NaNO_3$	Acetone + Cane Sugar
100%	24	21	17
95%	67	83	55
90%	92	113	82
85%	100	132	86
80%	94	134	63

TABLE VI

INFLUENCE OF $NaNO_3$ AND SUCROSE ON THE INCREASE IN WEIGHT OF 50 WRINKLED PEA SEEDS SOAKED IN 80% ACETONE

SOLUTION (100 ml)	WEIGHT IN GRAMS AND PER CENT INCREASE		
	At Start	One Half Day	One Day
80% acetone	12 62	13 08 (3 7)	14 09 (11 7)
80% acetone + 1 M $NaNO_3$	13 05	14 44 (10 7)	15 25 (16 9)
80% acetone + 10 g cane sugar	13 01	13 31 (2 3)	13 92 (7 0)

SUMMARY

The data obtained by Willstätter and Stoll (1913) on the amount of chloroplast pigments extractable from dried nettle leaf powder by methanol, ethanol, acetone and their aqueous dilutions seem to be a net result of the permeability of the plant material to the solvents and of the solubility of the chloroplast pigments in the respective solvents Seeds of sweet corn, soybean, and wrinkled pea were soaked in 100%, 95%, 90%, 85% methanol, in 100%, 95%, 90%, 85%, 80% ethanol, and in 100%, 95%, 90%, 85%, 80% acetone Weighings were made immediately before soaking and at the end of 1, 4, and 7 days Length measurements were also obtained from soybean seeds The weight increases during the first day for wrinkled pea seeds were 10 2% in absolute methanol, 1 4% in absolute ethanol, and 0% in anhydrous acetone With aqueous dilutions and also for longer periods of time the increases were greater The data for soybean seeds and for sweet corn seeds were the same comparatively as for wrinkled pea seeds

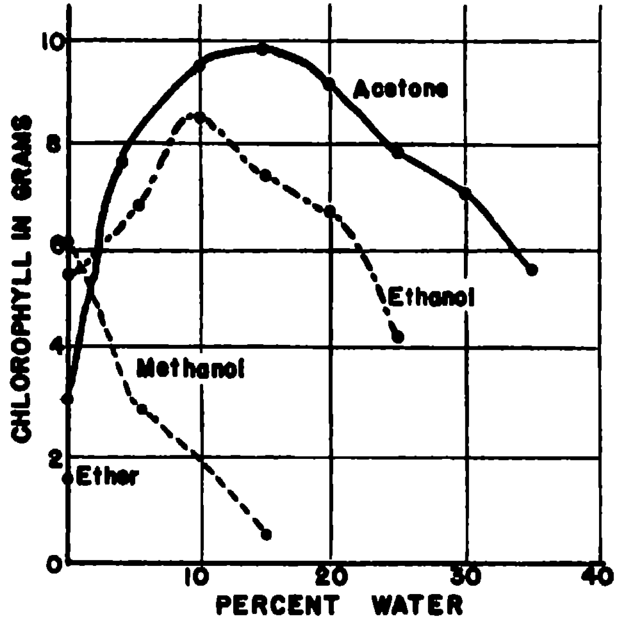

Fig 4 Extractability of chlorophyll from dried and pulverized leaves by various organic solvents After Willstätter (1915, p 335)

Sodium nitrate decisively increases the amount of chloroplast pigments extracted from dry nettle leaf powder in one hour by 80% acetone, and cane sugar decreases the amount A corresponding effect is registered by the sodium nitrate and the cane sugar on the initial rate at which seeds imbibe 80% acetone

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THIONYLDIACETIC ACID—CORRECTION

In the July, 1949, issue of The Ohio Journal of Science, Mr Dodson and I were the authors of a paper, titled "Thionyldiacetic Acid" In this paper we stated that Larsson had reported, in 1940, that he had obtained thionyldiacetic acid with a melting point of 109° C (Svensk Kem Tids, 52 9–15)

A personal communication from Professor Larsson points out that we were in error and that the melting point of 109° C was that of oxythiodiacetic acid and not thionyldiacetic acid We acknowledge the error which, though unintentional, is to be regretted —H G Oddy

A NEW SPECIES OF DIKRANEURA FROM WITCH-HAZEL
(HOMOPTERA—CICADELLIDAE)

DWIGHT M DELONG,
Ohio State University Columbus, Ohio
AND
HERBERT H ROSS,
Illinois Natural History Survey, Urbana, Illinois

While collecting in a wooded area in the Great Smoky Mountains National Park in Tennessee, an interesting new species of *Dikraneura* was collected from witchhazel, *Hamamelis virginiana* To our knowledge, this is the first time that a cicadelline leafhopper has been reported from this host, which thus adds a new plant genus and family to the biological orbit of the Cicadellinae

This new species has posed a taxonomic problem in that it agrees very well with venational and other general characteristics of the genus *Dikraneura*, but the male genitalia are extremely different from any described North American species, and from any European species illustrated by Ribault Especially peculiar are the forked and clasplike pygofer hook and the very peculiar aedeagus, Fig 1 At first we considered erecting a new subgenus to receive this species, but believe that for the present it would be more satisfactory to simply indicate this as a distinctive species group

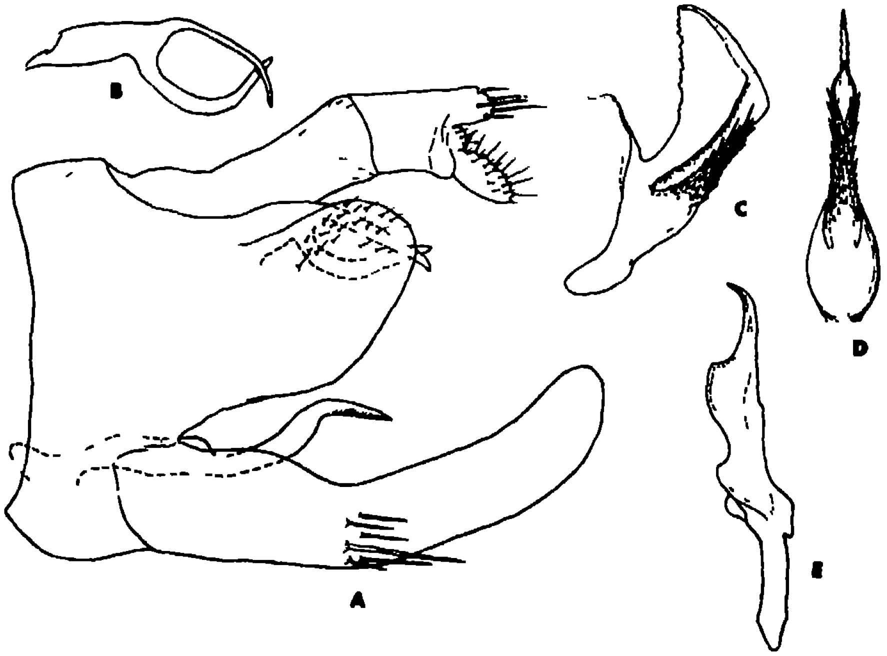

FIG 1 *Dikraneura hamar* male genitalia A, lateral aspect of external parts, B, ventro-lateral aspect of pygofer hook, C aedeagus lateral aspect D, aedeagus posterio-ventral aspect E style ventral aspect

Dikraneura hamar n sp

A pale, yellowish, blunt-headed species resembling *Forcipata* in general appearance. Length 3 5 mm

The vertex is produced, tapered, and blunt at apex In general appearance the insect is narrow with the wings decidedly longer than the abdomen The vertex, pronotum and scutellum are white tinted with yellow The elytra are lemon yellow subhyaline The wings are white subhyaline.

The female seventh sternite is roundedly produced

The male plates are long and narrow The style in ventral view is concavely narrowed on the outer margin at the apex so as to form a narrow sharp-pointed spine which curves outward at the apex The aedeagus in posterio-ventral view appears enlarged at base and narrowed, tapering to a slender apex In lateral view it appears broad with a basal pubescent ventral portion and a broadened, blade-like apical portion serrate on the anterio-dorsal margin The pygofer bears a dorso-caudal hook on each side which is divided into two long terminal spines which are widely separated at base and usually converge and overlap at apex

Holotype male—Chimneys Campground, Great Smoky Mountains National Park Tennessee, September 1, 1948, from *Hamamelis virginiana* Ross and Stannard *Allotype female* and 32 *paratypes*—Same data Holotype allotype and male and female paratypes in the collection of the Illinois Natural History Survey, male and female paratypes in the DeLong Collection at The Ohio State University

* *

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OHIO'S STATUS AS A GAME AND FUR PRODUCING STATE

DANIEL L LEEDY,[1]
U S Fish and Wildlife Service
Washington, D C

That Ohio is a great agricultural and industrial State and also ranks high in the value of minerals produced, particularly in coal clay products, limestone, salt, gypsum, sand and gravel are well known facts That Ohio ranks high as a game and fur producing State, is known by relatively few people, even within the State Thinking that some information on game and fur production would be of interest to the readers of the Ohio Journal of Science, the present article was prepared

HUNTING PRESSURE IN OHIO

Ohio has an area of approximately 41,000 square miles and ranks 35th among the states in size Nearly seven and one-half million people live within the State and, of these residents, about one in seven hunts or fishes or does both (Leedy and Dambach, 1948)

In a detailed study of game and wild fur production and utilization throughout the United States, Miller and Powell (1942) calculated that there were only 51 acres of potential huntable area per Ohio hunting license holder in 1935 In these calculations approximately 19 5 percent reduction in total land area was allowed for urban areas, highways, railroad rights-of-way, farmsteads, state game refuges and Army reservations on which public hunting was prohibited by law No allowance was made for lands not available to hunters because they were posted by private landowners nor were the hunters, who hunted legally or illegally without licenses, included It was pointed out that, of the estimated 20,996,911 acres of potential huntable land, 90 6 percent was privately owned and that a like percentage of this land was devoted to agriculture

As one drives through the rich, agricultural area of western Ohio during March or early April he finds that more than one-third of the area is practically devoid of cover and includes plowed ground, soy bean stubble left after the beans have been combined and corn which has been cut and removed from the fields In addition, many of the pastures and pastured woodlots provide but a minimum of cover

The lush cover, available for farm game in the summer, has been reduced by the harvesting of hay and grains, further reduced by the clipping of grain stubble, fall and spring plowing, by winter winds, rain and snow and by the mowing and burning of ditch banks and fence rows until by April, with so little cover remaining, one wonders how game can survive in any considerable numbers at all

It is likely, therefore, that the areas hunted were subjected to a hunting pressure considerably in excess of one hunter per 51 huntable acres in 1935 when the average ratio for the United States was estimated by Miller and Powell (1942) to be one hunter per 277 acres At that time (1935) only New Jersey, Pennsylvania and New York, with hunter-acre ratios of 1 34, 1 39 and 1 47 exceeded Ohio in hunting pressures In more recent years Dambach (1948) calculated a ratio of hunting licenses to huntable acres in Ohio of 1 30 If non-licensed hunters had been included, the ratio would have been increased still more

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[1] Most of the data upon which this paper is based were collected while the writer was Leader, The Ohio Wildlife Research Unit Ohio State University, Columbus 10, Ohio The Ohio Division of Conservation The Ohio State University, The U S Fish and Wildlife Service and The Wildlife Management Institute cooperating

OHIO HUNTER PREFERENCES AND HUNTING PRESSURE ACCORDING TO SPECIES

Following the 1946 and the 1947 hunting seasons the Ohio Division of Conservation and Natural Resources and the Ohio Wildlift Research Unit contacted, through questionnaires, samples of Ohio hunters in order to learn more about hunter preferences, wildlife economics and the game kill (Leedy, 1947, 1948a) These surveys showed that, in 1946, for every 100 hunters who indicated a preference for hunting pheasants, 58 preferred rabbit hunting, 21 preferred gray squirrels, 14 preferred raccoons and 11 preferred fox squirrels, and that, in 1947, regardless of preferences, 81 percent of the hunters hunted cottontails, 70 percent hunted pheasants, 48 percent hunted fox squirrels, 31 percent hunted gray squirrels and 12 percent hunted raccoons

It is probable that hunter preferences for certain species are determined largely by the abundance and distribution of the game species and the ease with which they may be hunted In spite of the fact that pheasants are not as abundant or as widespread in Ohio as rabbits, however, these exotic birds are a preferred game species and thousands of hunters travel to favorite bird counties in the northwestern part of the State to hunt them On the basis of questionnaires returned by Ohio hunters following the 1947 season, approximately 16 percent of the license holders hunt or trap fur-bearing animals The raccoon is the most popular species for the night hunters and muskrats provide most of the trapping The number of Ohio hunters engaging in deer hunting within the State more than doubled from 1947 to 1948 During the latter year slightly less than 23,000 deer-hunting permits were issued (Chapman, 1949a) The number of Ohio grouse hunters is also increasing

Having seen something of the hunting pressure in Ohio, the preferences of hunters for various species and the scarcity of cover, let us see how Ohio game and fur production compares with that of other States

GAME AND FUR PRODUCTION IN OHIO AND OTHER STATES

A comparison of the numbers of game and fur animals taken in the various states can be made only with the appreciation that the kill data, if available at all, vary in completeness and accuracy from state to state and from species to species Most state-wide kill figures are based upon questionnaires returned by samples of hunters contacted by game departments or upon the estimates of game department field men The take of fur is often based upon reports of licensed fur buyers and may not represent the total harvest

Considerable progress has been made in wildlife bookkeeping during the last decade through the cooperation of hunters and State and Federal agencies, especially with respect to the take of big game, waterfowl and furbearers There is still much room for improvement, however, particularly concerning the kill of small game

In September, 1948, a questionnaire and an explanatory letter were sent to each of the 48 State game departments in an attempt to obtain some information as to the kill of various game species, the number of people engaged in big game hunting as compared with small game hunting and other items of interest The response of the State game officials in filling out and returning the questionnaires was excellent and the writer expresses his thanks for their cooperation Much of the information, thus obtained, was summarized for presentation at the 14th North American Wildlife Conference (Leedy, 1949)

The remaining data presented here on the game kill by states are necessarily incomplete and must be considered for what they are—the best estimates available It should also be remembered that the take of game and fur-bearing animals is not a true index of actual populations Weather conditions, the number of hunters and trappers per unit of area, hunting regulations and other factors affect the relative percentage of a game population that is harvested by hunters

TABLE I

STATISTICS, BY STATES, OF HUNTABLE AREAS, LICENSE SALES AND TAKE OF SELECTED GAME SPECIES

STATES	ESTIMATED POTENTIAL HUNTABLE AREAS IN ACRES[1]	RESIDENT AND NON RESIDENT HUNTING LICENSES SOLD DURING THE FISCAL YEAR ENDING JUNE 30, 1947[2]	ESTIMATED KILL OF SELECTED SPECIES DURING THE 1946 SEASON			
			Cotton tail Rabbit	Fox Squirrel	Gray Squirrel	Ring necked Pheasant
Alabama	20 359,934	203 097	500 000	3 000	120 000	
Arizona	48 119 127	49 673				
Arkansas	30 029 210	193,196				
California	89 968 393	483,176				
Colorado	60,150 185	414 274	271 803			256 550
Connecticut	2 395 648	49 061				
Delaware	1 039 046	21 408	59 843		23,777	1 134
Florida	29 841 801	101 411	No season	52,215	469 938	
Georgia	33 806 376	142 253	159 960			
Idaho	48 196 411	166 357	6,000			400,000
Illinois	30 617 802	426 270				
Indiana	18 963 858	369,125	3 600 000	1 775 000	450 000	70 000
Iowa	30 808 824	294 580	1 500,000	300 000	100 000	500 000
Kansas	43 381 708	176 538				
Kentucky	20,815 219	181 670	1,470,656			
Louisiana	26 388 909	170,396				
Maine	17,799,593	133 321			16,000	12 000
Maryland	5,338,309	118 566				1,125
Massachusetts	3 997 935	135 788	73 459		25 277	26,198
Michigan	32 394,698	1,046,839	1 306,973	786 002	77,731	904,367
Minnesota	43 330,430	495,370	186 055	92,789	231 672	801 372
Missouri	38 409 640	332 480	5,000 000	1 203 000	699,000	
Mississippi	25 989 720	183,279	298 000	86 000	693 000	
Montana	81 503 329	149,119				
Nebraska	45 753 279	220,688	500 000	200 000		2 000 000
Nevada	62 314,858	25,738				
New Hampshire	5 341 695	109,175	17 354		25 806	8,827
New Jersey	3 920 131	183,107	794,136		152,624	211 460
New Mexico	68 550 097	53 041	Not classed as game			4 000
New York	26,527 851	826,774	304 524		144 673	71 258
North Carolina	28 581 678	207,904	1,513,385	1,000	2,000 000	
North Dakota	39 193 662	70 036				800 000
Ohio	20 996 911	702 510	4 606 000	1 505 000	994,000	868 000
Oklahoma	36 499 250	165,431	Non-game	500 000	100 000	
Oregon	54 524 362	199,020	5 000		2,000	300 000
Pennsylvania	24 109 118	843 040	1 524,798			213 384
Rhode Island	517 377	13 516				
South Carolina	17 261 083	171 458				
South Dakota	41 408,999	210 978				3 550,132
Tennessee	21 671 088	246 824				
Texas	155,061 620	234 720	Non-game			
Utah	47 543,363	108,041				200,000
Vermont	5 258 292	72 248				
Virginia	22 914 408	285 380	130 000		150,000	
Washington	35 882,835	381 174				217,000
West Virginia	18 823 713	264,683	725 000	285 000	1 625,000	
Wisconsin	30 469 631	378 941	755,200	375,546	638,474	437 428
Wyoming	54 406,415	55 089	Non-game			65,000

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[1] After Miller and Powell (1942)

[2] Taken from Fish and Wildlife Service News Release dated February 8, 1948, based on data compiled by the Branch of Federal Aid in Wildlife Restoration

In analyzing the questionnaires returned by 39 State game departments, it was evident that the cottontail rabbit, ring-necked pheasant, gray squirrel and fox squirrel furnished hunting for a high percentage of the country's nimrods Considered collectively, ducks also provide much hunting, as do the bobwhite quail and the white-tailed deer (Leedy, 1949)

How Ohio ranked in the harvest of the first four species in 1946 is indicated in Table I These and other species will be considered as follows

Cottontail rabbit —Ohio had a calculated kill of 4,606,000 rabbits in 1946, ranking a close second to Missouri, among 24 states reporting Following Ohio were Indiana, Pennsylvania, North Carolina Iowa, Kentucky and Michigan

Fox squirrel —In the reported take of fox squirrels by 14 states, Indiana ranked first with 1,775 000 followed by Ohio with 1,505 000 Missouri with 1,203,000 and Michigan with 786,000 In each of the other states reporting, less than 500,000 fox squirrels were taken by hunters

Gray squirrel —Among 21 states reporting the kill of gray squirrels, Ohio ranked third with 994,000 estimated to have been taken, following North Carolina with 2,000,000 and West Virginia with 1,625 000

Ring-necked pheasant —South Dakota, with a reported hunter take of 3,550,132 pheasants and Nebraska, with an estimated kill of 2,000,000 pheasants, far out-ranked any of the other 22 states reporting Following Nebraska were Michigan with a reported kill of 904,367, Ohio with 868 000 and North Dakota with 800,000

Waterfowl —Ohio is not a leading state in the production or kill of waterfowl For the fiscal year ending June 30, 1947, it ranked 24th among the states in the number of Federal duck stamps purchased with 37,105 out of a total of more than 2,000,000 issued Of the 26,000,000 ducks estimated to have been bagged by hunters in the United States in 1946, relatively few were killed in Ohio Only 409 out of 8,449 Ohio hunters, who returned questionnaires following the 1946 season, had bagged any ducks (Leedy, 1947)

Bob-white quail —There has been no open season on quail in Ohio since 1913 Quail population trends have apparently fluctuated in about the same manner as they have in Indiana where hunting is permitted On a nation-wide basis, the harvest of quail probably exceeds that of the ring-necked pheasant In northern Ohio, the bobwhite is approaching the northern limits of its range where it is subject to sharp population declines resulting from severe winter weather and other factors

White-tailed deer —This animal probably ranks within the first ten game species in providing sport to hunters in the United States According to Chapman (1939) white-tailed deer nearly, if not completely, disappeared from Ohio about 1904 due to persecution and habitat depletion Through the introduction of deer at the Roosevelt Game Preserve in southeastern Ohio 1922 to 1930, and the spread of deer into northeastern Ohio from Pennsylvania, the Ohio deer herd recently has increased rapidly in the areas reverting to brush and forest cover Chapman (1949a) estimated that approximately 1,200 deer were taken in northeastern Ohio in 1947 and nearly 3,000 in 1948 Compilations made by the U S Fish and Wildlife Service (1948) of big game populations in 1946 showed Ohio to rank 36th among the 48 states in the estimated number of white-tailed deer present

Mourning dove —The mourning dove ranks high among the game birds in total kill in the United States Approximately two and one-half million were reported taken in eleven of the states having open seasons in 1946 Like the bobwhite, however, the dove, as a game bird in Ohio, was given protection from hunting 1913 to 1947, and, in the latter year, was designated a song bird (Dambach 1948) In 1949 it was again classified as a game bird but no hunting was permitted

Ruffed grouse —In 1947, approximately nine percent of the hunters returning questionnaires reported that they had hunted grouse during the season (Leedy, 1948a) The reversion of land to brush in eastern Ohio is favorable to an increase in grouse populations The numbers of this game bird that are harvested will probably remain relatively small because of its wily nature and the difficulties in hunting it In 1947, for example, 501 grouse hunters bagged only 246 grouse

Hungarian partridge —This exotic game bird after having had legal protection from hunters, 1913 to 1917, was hunted in Ohio until 1947 when it was again protected due to its scarcity In 1946 less than one percent of Ohio's hunters bagged a Hungarian partridge and the total kill in the State was probably less than that for ruffed grouse (Leedy, 1947) Eighty-one out of 8,449 hunters reporting, however, killed 194 partridges

The Hungarian partridge, relatively abundant in northwestern Ohio in the early 1930's, has decreased sharply in numbers throughout most of its range in the United States Many states having an open season on partridges in 1936 had closed the season in 1946 and the kill reported by nine states, the latter year, was 61 percent less than that of 1936 In 1946, Idaho reported an estimated partridge kill of 50,000, Ohio, approximately 16,500, and Indiana, 15,000 (Leedy, 1949)

Other game animals —There are a few black bears in the hilly forested sections of southern Ohio but not enough to warrant an open season on them Likewise, Ohio has no jack rabbit, snowshoe hare, black-tailed deer, mule deer, antelope, moose, elk, Valley quail, Gambel quail, white-winged dove, sharp-tailed grouse, prairie chicken or wild turkey hunting While considerable numbers of jack rabbits, showshoe hares and others of these species are killed in the United States the totals are far less than for such species as the cottontail rabbit, the fox and gray squirrels and the ring-necked pheasant which Ohio has in relative abundance

Insufficient information on the kill of rails, gallinules and woodcocks is available to indicate their status in Ohio as compared with other states Of these three migratory birds, woodcocks are killed in the largest numbers Two hundred of 5,599 representative Ohio hunters reporting at the close of the 1947 hunting season had killed 567 woodcocks, 76 hunters had killed 95 gallinules and 71 hunters had killed 54 rails (Leedy, 1948b)

Fur animals —During the ten-year period 1938 to 1947, Ohio fur dealers reported purchasing an average of more than 900,000 pelts annually (Leedy, 1948b) A comparison of the fur crop harvested during the 1946–1947 season with the ten-year average crop, 1938–1947, is shown in Table II The estimated annual take of fur animals on a nation-wide basis is indicated in Table III

The figures on fur production in Ohio do not include the pelts shipped directly to out-of-state fur dealers by Ohio hunters and trappers It is believed (Leedy, 1948b) that at least 10 percent of the total Ohio fur catch is disposed of in this way On this basis the average annual take of fur animals in Ohio would be approximately one million pelts placing Ohio among the first half dozen States in fur production In recent years, 1946–1947, the raw furs taken by Ohio hunters and trappers have had an annual value of approximately $2,000,000

As evident in Tables II and III, Ohio's common fur bearers are the same species that constitute the bulk of the furs produced in the United States Louisiana as shown by Ashbrook (1948), produces far more fur animals than any other State Among six of the leading fur producing states—Louisiana, Michigan, Minnesota, Ohio, Pennsylvania and Wisconsin—Ohio's ranking in the number of pelts reported taken by species in the 1946–1947 season was as follows Fox (primarily red and gray), Pennsylvania first, Ohio fifth, mink, Louisiana first, Ohio fifth, muskrat, Louisiana first, Ohio third, opossum, Louisiana first, Ohio second, skunk, Minnesota first, Ohio fifth, and weasel, Minnesota first, Ohio fifth (Ashbrook, 1948)

Due to their relative scarcity, striped skunks have been given protection from hunting and trapping in Ohio in recent years (1947 and 1948 seasons) Raccoons and foxes, on the other hand, have been more abundant than usual

Among other fur animals that occur in the State are the beaver, the badger and the nutria (*Myogaster coypus*) Chapman (1949b) estimated that there were from 100 to 125 beavers in Ohio in 1948, mostly in counties bordering Pennsylvania There is no open season on the beaver in Ohio at present

There are relatively few badgers in Ohio Usually less than ten pelts are purchased annually by Ohio fur dealers, although other individuals are prepared by taxidermists or kept alive by their captors because of their scarcity

The nutria, an exotic also known as South American swamp beaver or coypu, has been reported in Ohio (Petrides and Leedy, 1948) but is apparently found only as stragglers that have escaped from fur farms

TABLE II

COMPARISON OF THE 1946–1947 OHIO FUR CROP WITH THE TEN YEAR AVERAGE 1938–1947
(After Leedy 1948b)

SPECIES	NUMBER OF PELTS TAKEN[1]		PERCENTAGE COMPOSITION OF FUR CATCH	
	1938–47 Av	1947	1938–47 Av	1947
Red fox,	9 984	14,592	1 1	1 6
Gray fox	6 362	5 009	7	6
Mink	12,384	14 059	1 4	1 5
Muskrat	648 905	698 166	70 8	75 6
Opossum	120,866	73 014	13 2	7 9
Raccoon	45 469	92 615	5 0	10 0
Skunk	61 760	14 914	6 7	1 6
Weasel	10,147	11 442	1 1	1 2
Total	915 877	923 811	100 0	100 0

[1] These figures do not include pelts bought by or shipped directly to out of State fur dealers by Ohio hunters and trappers

TABLE III

ESTIMATED NUMBER OF PELTS PRODUCED ANNUALLY IN THE UNITED STATES[1]

Species	Average Annual Production	Species	Average Annual Production
Muskrat	20 000 000	Ringtail	100 000
Opossum	3 000 000	Bobcat	40,000
Skunk	2 500 000	Badger	25 000
Raccoon	2 000 000	Nutria	20 000
Mink	800 000	Otter	15 000
Fox (red gray kit and swift)	700,000	Marten	5 000
		Wolf	2 500
Weasel	400 000	Fisher	500
Coyote	300,000	Canada lynx	25
Beaver	125,000	Wolverine	20

[1] Data supplied by Mr Frank G Ashbrook, In Charge Wild Fur Animal Investigations Fish and Wildlife Service, U S Department of the Interior

The bobcat, Canada lynx, coyote, fisher, marten, otter, ringtail, wolf and wolverine, either not present in Ohio at all or so rare as not to warrant attention here, are taken in relatively small numbers where they still occur in the United States

SUMMARY

1 Ohio, ranking 35th in size among the states, and with a population of approximately seven and one-half million people, has a hunting pressure exceeded by no more than three or four states

2 Although well known for its industrial greatness and its agricultural and mineral production, relatively few people know how it ranks as a game and fur producing state

3 Wildlife bookkeeping methods, although considerably improved in recent years, are still inadequate The kill figures presented are to be regarded only as estimates but it is believed they are sufficiently accurate to permit rough comparisons of game and fur production in the various states

4 Limitations of kill figures as indices of game and fur animal populations are indicated

5 The cottontail rabbit, fox squirrel, gray squirrel and ring-necked pheasant provide hunting for a high percentage of the country's hunters In 1947, the percentage of Ohio hunters hunting these species was 81, 48, 31 and 70 respectively

6 Based upon data furnished by State Game Departments in response to a questionnaire, Ohio ranked first in the combined kill of these four species in 1946

7 According to compilations made by the Branch of Wildlife Research, Fish and Wildlife Service, Ohio ranks among the six leading states in fur production

8 Muskrats comprise approximately three-fourths of the state's average fur catch which totals nearly a million pelts and which, during recent years, has been worth about two million dollars annually

9 The six leading fur animals in the United States, considering the number of pelts produced, are the muskrat, opossum, skunk, raccoon, mink, fox (red and gray) and weasel These are the fur animals most common in Ohio

10 Thus, while Ohio has a relatively small kill of waterfowl and big game animals and lacks certain game and fur species altogether, it is one of the leading states in the small game and fur animal harvest

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CYTOECOLOGICAL STUDIES OF SILENE ROTUNDIFOLIA NUTT, S VIRGINICA L, AND HYBRID[1]

MARGARET B HEASLIP
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Columbus Ohio

This paper is the result of certain cytoecological studies of *Silene rotundifolia* Nutt the Round-leafed catchfly, and *S virginica* L the Fire pink (CARYOPHYLLACEAE) *S rotundifolia* was described by Nuttall (6) in 1807 Its habitat was described as "moist ledges of rock cliffs' in Ohio and Tennessee Since then its distribution has been more accurately mapped from herbarium records and it is known to occur on rock ledges or in cliff crevices of limestone or sandstone throughout its range in Ohio, Tennessee Kentucky Virginia, West Virginia and northern Alabama and Georgia These habitats which are exposed to high light intensities often appear dry but these plants are neither 'xerophytes nor is water usually a limiting factor, as the tap root of *S rotundifolia* extends into a water source in the joint and bedding planes Wolfe, Wareham, and Scofield (7) in their work on microclimates in southern Ohio show that the environmental conditions in rock crevices are considerably different from those in the surrounding forest and open areas

S virginica which was studied in conjunction with *S rotundifolia*, has a much wider distribution It grows in open woodlands and forest borders in southern New Jersey, western New York and southwestern Ontario to Minnesota and south to Missouri and Georgia (1 4 5) Although these two species often grow in the same region, one has never been known to invade the habitat of the other nor has hybridization of the two been known to occur in the field

In order to further analyze the ecological requisites of this species, hybrid material for study was obtained by crossing *S rotundifolia* with *S virginica*, one of the two other red flowered species of *Silene* growing in Ohio Crosses with *S rotundifolia* as the ovule parent and reciprocal crosses were made and repeated successfully These species are cross fertile and approximately 100 seeds externally resembling those of the ovule parent develop in each ovulary after cross fertilization

The F_1 hybrid, like both parents is perennial slender, ascending or reclining, viscid-pubescent, branched, the blades of the lower leaves taper into winged petioles, the upper leaves are sessile, the calyx is tubular-campanulate, somewhat enlarged by the ripening pod The lower and basal leaves of the hybrid are intermediate between the obovate or broadly spatulate leaf blades of *S rotundifolia* and the oblanceolate leaf blades of *S virginica* The upper leaves are intermediate between the broadly oblong or orbicular-ovate leaves of *S rotundifolia* and oblong-lanceolate leaves of *S virginica* The petals of the hybrid flowers are intermediate between those of the parent species in size, color and shape The petals are two-cleft or two-lobed as are those of both parents, but the degree of laciniation varies between the deeply incised two-cleft petals of *S rotundifolia* and the less incised two-cleft petals of *S virginica*

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[1] Publication 516, Department of Botany and Plant Pathology The Ohio State University Personal acknowledgments are made to John N Wolfe and Elton F Paddock of The Ohio State University

The number of flowers per plant and the length of the flowering period is greater in the hybrid than in either parent The vegetative growth of the hybrid is luxuriant and many perfect flowers develop on each plant The amount of pollen in each anther of the hybrid is much less than that of either parent, and the filaments are often weak and short In both parent species, the petals open, five stamens elongate, the anthers begin to dehisce, and then the other five stamens and the styles elongate or the filaments elongate This is followed by elongation of the styles and expansion of the three stigmas Pollination usually takes place as the pistils grow to their ultimate height However, the stamens of the hybrid sometimes never elongate, or they do not dehisce until after the pistils have grown above them, or the filaments collapse before the anthers dehisce Thus self-pollination often fails to occur in the hybrid, but this failure was eliminated in experimentation by hand pollinating After pollination occurs in the hybrid, the ovulary begins to swell, finally dehiscing when mature, but only shrunken, shriveled ovules occur within the small capsule

From the following breeding results it appears that the hybrid is both self and cross sterile

S hybrid ♀ × *S hybrid* ♂
(repeated 1500 times)
no seeds

S hybrid ♀ × *S rotundifolia* ♂
(repeated 131 times)
no seeds

S hybrid ♀ × *S virginica* ♂
(repeated 103 times)
no seeds

There are usually more than 100 ovules in each ovulary and 1,734 hybrid flowers were either self or cross pollinated None of the 170,000 ovules observed developed into seeds

This failure of viable seed to develop does not appear to be the result of adverse environmental conditions as *S rotundifolia* and *S virginica* plants growing at the same time in conditions similar to those of the hybrid were "setting" seed in the ovularies of both cross and self-pollinated flowers Cytological studies were then undertaken in an attempt to explain the failure of seeds to develop

Observations of microsporogenesis were made in *S rotundifolia*, *S virginica*, and the hybrid

Slides were prepared for studying microsporogenesis by smearing the anthers of one bud in acetocarmine The anthers in the buds collected in early morning contained more pollen mother cells in desirable stages than those collected later in the day Immediately after collection, the buds were put in a 3 1 absolute alcohol-acetic acid fixing solution Twenty-four hours later they were transferred to a 70% alcohol solution

S rotundifolia pollen mother cells observed had regular meiotic divisions with the formation of four microspores Cells observed in late diakinesis and early metaphase I contained 24 bivalents (Fig 1 A), and those in anaphase I had 24 univalents moving toward each pole (Fig 1 B), illustrating regular pairing and disjunction The diploid chromosome number of *S rotundifolia* is 48

Microsporogenesis is also regular in *S virginica* Although no counts were made from cells in metaphase I, pairing was regular and all bivalents lined up on the metaphase plate as in Fig 1 C All cells observed in metaphase II had 24 univalents in each nucleus, (Fig 1 D) Pairing and disjunction appear to be regular The diploid chromosome number of *S virginica* is 48

Blackburn (3) reported the diploid chromosome number of 44 species of *Silene* in various sections of Europe as 24 In 1928 she reported *S schafta* to have a diploid chromosome number of 24, 48, or 192 Love (3) in 1942 found *S pontica* (Rumania) and *S vallesia* (Alps) to have diploid chromosome numbers of 48

No records of chromosome counts on American species of *Silene* were found reported in the literature Relative to the European species, these American species appear to be basically tetraploid

Many meiotic irregularities occur during microsporogenesis in the hybrid Chromosome studies revealed that this hybrid has a diploid number of 48, as do both *S rotundifolia* and *S virginica*, and that gross morphology of all its 48 chromosomes is so much alike that it is not possible to identify those of maternal or paternal origin (Figs 2 A-B) Pairing was highly irregular, univalents, bivalents, and

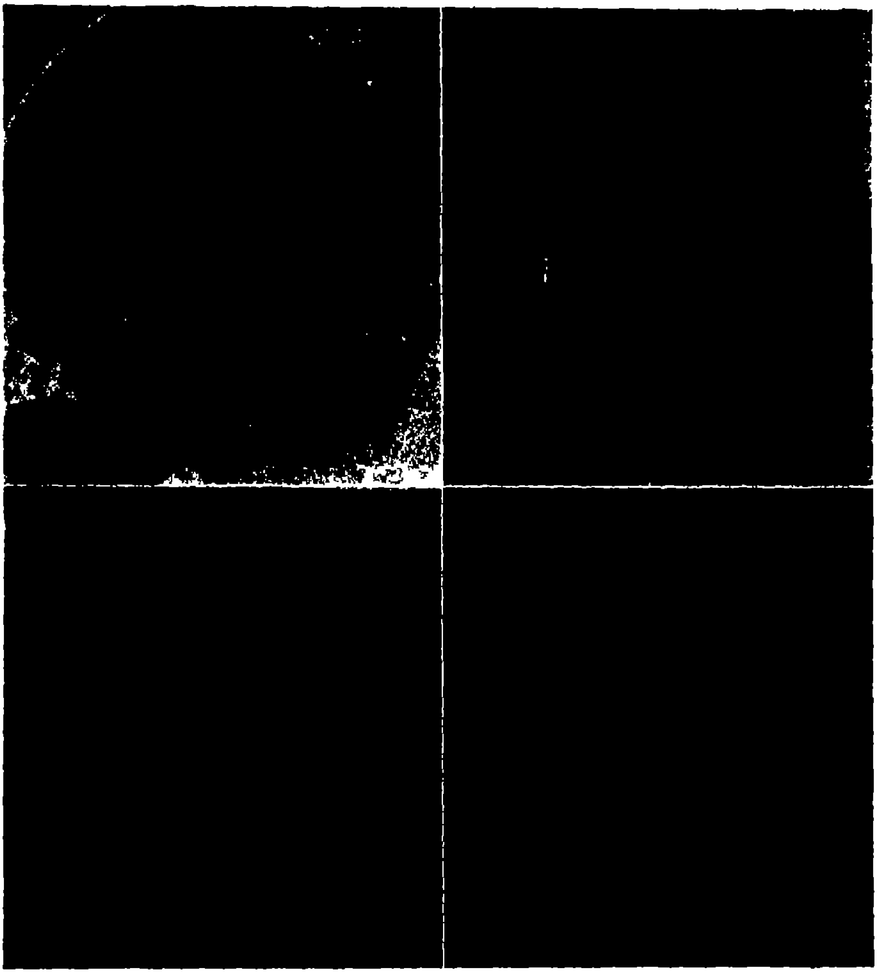

FIG 1 (A) *Silene rotundifolia* late diakinesis, 24 bivalents (B) *S rotundifolia* anaphase I 24 univalents moving toward each pole Note the similar morphology of all chromosomes (C) *S virginica* metaphase I (D) *S virginica* metaphase II, 24 univalents in each nucleus 1000× Photomicrographs by Tillman J Johnson

multiple associations being formed in varying numbers from one cell to another (Fig 2 B) Lagging was often observed in both the first and second meiotic divisions (Fig 2 C) The lagging chromosomes moved at random to one pole or the other or they were sometimes incorporated in micronuclei Although four microspores were usually formed from each microspore mother cell, the number varied from one to six (Fig 2 D) Each of these irregularities, failure of synapsis, formation of multiple associations, lagging of chromosomes, unequal numbers of chromosomes moving to each pole and the formation of micronuclei would contribute toward disturbance of the genetic balance of gametes and therefore to the sterility of the hybrid

Although *S rotundifolia* grows on cliff faces and rock ledges and *S virginica* grows in open woodlands and woodland borders they are often geographically close enough for cross pollination to take place but this does not usually occur because self pollination takes place in both species before there would be much probability of cross pollination

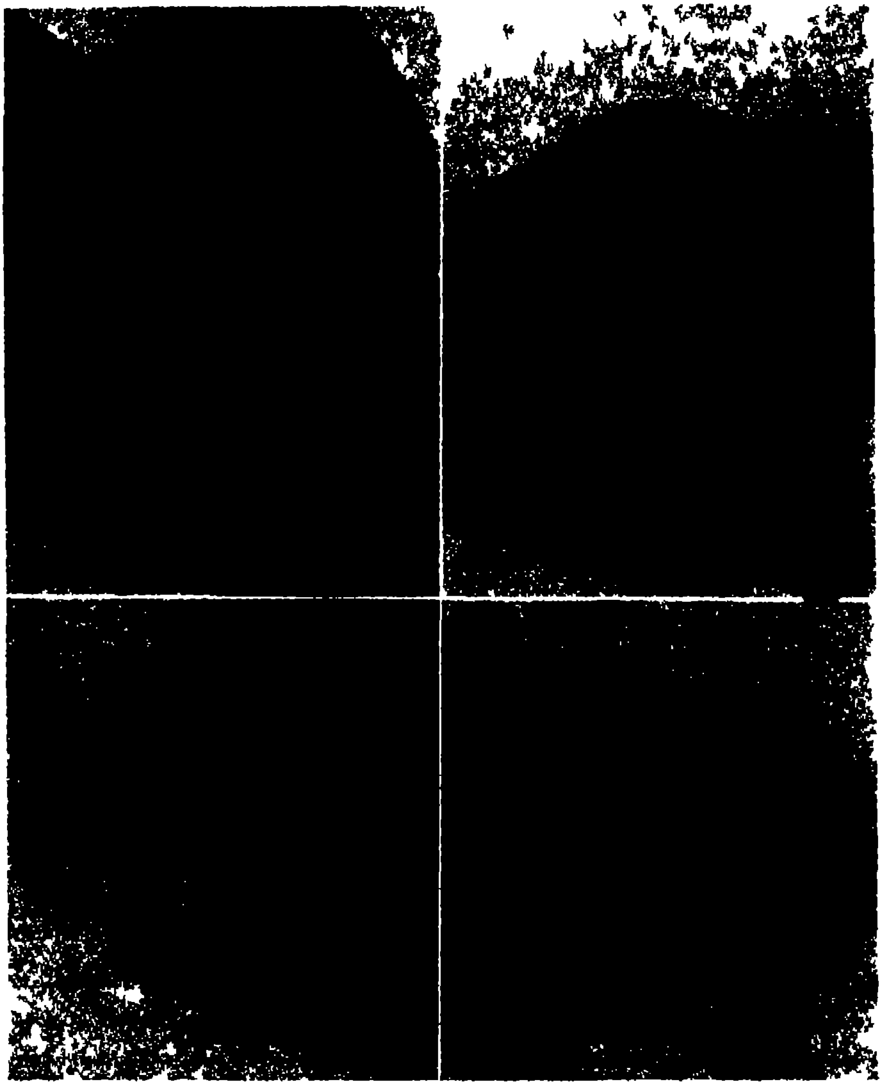

Fig 2 (A) Hybrid metaphase I pairing irregular chromosomes of each genome morphologically similar (B) Hybrid metaphase I univalents bivalents and multiple associations present (C) Hybrid anaphase I three chromosomes lagging (D) Hybrid polyspory (more than four spores) resulting from meiotic irregularities 1000× Photo micrographs by Tillman J Johnson

From the experimental evidence it is obvious that *S rotundifolia* and *S* *virginica* are genetically similar enough to hybridize, and a vigorous vegetative hybrid develops, but the genetic dissimilarities between the two parents are great enough to result in a high degree of sterility in the hybrid While the chromosomes of each of the above species appear to be so much alike in both number and gross morphology, the irregularities in synapsis between the two groups of chromosomes is evidence of qualitative and structural differences between the chromosome groups Some of the chromosomes of one species have evolved so differently from those of the other species that synapsis no longer occurs between the two or if it does, no chiasmata are formed and the chromosomes separate before first metaphase, becoming univalents Structural changes must have occurred in some chromosomes because various multiple associations greater than four are present at first metaphase of meiosis in the hybrid (Fig 2 B) Usually only homologous portions of chromosomes synapse and thus it may be inferred that some chromosomes in the hybrid contain portions which are homologous with portions of two other chromosomes It may then be further inferred that at some time in the evolutionary history of the parent species segmental translocations between non-homologous chromosomes may have taken place separately within one or both of the species

An amphiploid is most likely to be fertile and vegetatively vigorous in the first and following generations if its parent species are closely enough related that a vigorous F_1 hybrid results from crosses, yet remotely enough related that the balance between their combined genomes in the F_1 hybrid can not be perpetuated (2) The present hybrid fulfilled both requirements Therefore attempts were made to create a fertile and vegetatively vigorous amphiploid from the hybrid Colchicine in water and in a lanolin paste at concentration of 05%, 1%, 2%, 5%, or 1 0% was applied to the growing stem tips of hybrid seedlings However, all attempts were unsuccessful, as the colchicine only caused a temporary stunting of vegetative growth

From cytological studies of the hybrid, it appears that if an amphiploid were to be obtained, it might not be entirely fertile during either the first or succeeding generations Some of the chromosomes of one parent were found to be homologous with those of the other parent, a relation close enough to allow interspecific segregation in their amphiploid This interspecific segregation might disturb the parental gamete balance and thereby produce sterility or partial sterility in the amphiploid Furthermore, such an amphiploid would be basically octaploid

SUMMARY

The diploid chromosome number of *Silene rotundifolia* and *Silene virginica* is reported as 48 They are therefore basically tetraploid Microsporogenesis is regular in each of these species Both species also are self- and cross-fertile F_1 hybrids resulting from crossing them are vegetatively vigorous but highly self and cross sterile It is suggested that this sterility might be attributed in part or wholly to the observed disturbance of the genetic balance of gametes by meiotic irregularities such as failure of synapsis formation of multiple associations, chromosome lagging, and the formation of micronuclei

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BRACHINUS ATBARAE N SP (COLEOPTERA, CARABIDAE)[1]

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This species is very similar to *B fumans* (Fab) in many respects and would key to that species in the papers of Leconte, 62, Chaudoir, 68, and Blatchley, '10 The elytra are deep violet blue and the rest of the body is reddish brown with the exception of the metepimera, metepisterna and outer sixth of the abdominal segments which are blackish The clypeus is much more convex than in *B fumans* and the frontal striae of the head are less deeply impressed and although somewhat rugose have only a few obsolete punctures in them These punctures are more numerous and much more distinct in *B fumans* The head is very smooth discally and the punctures of the area posterior to the eyes are much weaker and less numerous than in *B fumans* The prothorax is slightly wider in proportion to the length (6 5) than in *B fumans* (5 5 5), the sinuation before the hind angles is greater and the hind angles are more prominent The punctures of the prothorax are much less distinct than in *B fumans*, but the rugosity, median line, and transverse impressions are very similar The scutellum is finely rugose and is medially sulcate on its posterior half, whereas in *B fumans* this sclerite is finely rugose but is not sulcate The costae of the elytra are less developed than in *B fumans*, and the punctation is similar, but the hairs are shorter and less conspicuous The next to the last dorsal abdominal segment of the male of *B albarae* has a very short rather blunt carina which ends in a blunt denticle on the middle of the posterior margin There is no trace of this structure in the female and it is not present in either sex of *B fumans* Length 11 to 12 mm

Holotype male Atbara B C, Canada, 24-IV-'45, G Stace Smith, Coll

Allotype female Atbara B C Canada 7-V-'46 G Stace Smith, Coll

Paratypes Atbara B C, Canada 1 female 26-IX-'44 1 male 27-IX-'44 1 male 20-VI-'46, 1 female, 24-VI-'46, 2 males, 1 female 5-VII-'46 2 males, 3 females, 21 VII-'46, 1 male, 20-IX-'46 All collected by G Stace Smith

The Holotype, Allotype, and 5 paratypes are in possession of the author and 8 paratypes are in the collection of Mr G Stace Smith

The author is indebted to Mr G Stace Smith of Creston, B C, for the opportunity to study this species Mr H B Leech had previously recognized the species as near *B fumans* (Fab)

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NEW MEMBERS

More than 150 Ohioans joined the Ohio Academy of Science in the month of April Of these, more than 50 were physicians

Is your physician a member?

BODY WEIGHT, SURVIVAL TIME, COLORATION, AND WATER CONTENT OF SKELETAL MUSCLES OF ADRENALECTOMIZED FROGS[1]

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From studies of slightly more than 1300 operated frogs, of which between 65% and 70% were adrenalectomized and the remainder were renal damaged ("sham"-operated controls), various observations relative to changes in body weight, survival time, integumental coloration, and water content of skeletal muscles are available to extend, as well as to correlate, the prevailing literature relative to the effect of adrenalectomy in frogs.

Male *Rana pipiens* weighing between 30 and 35 g. may be arbitrarily divided into four groups: adrenalectomized frogs whose postoperative body weights were either (a) *controlled* to be within ±1.5 g. of their respective mean preoperative values, or (b) *uncontrolled*, and the control frogs—(c) *renal damaged*, and (d) *unoperated*. During an interval from 10 days prior to adrenalectomy until the time of death, individual daily records were kept with regard to various pertinent data. Because of the subjective nature of interpreting integumental color changes, the same two persons[2] always made the observations.

All frogs were unfed. The appearance of ample testicular fat at autopsy was considered as evidence of at least a "basal" state of nutrition, otherwise the frogs were excluded from the results.

Data derived from the four groups of frogs are summarized in Fig. 1. The various mean values for the respective data for each group (25 frogs/group) have been statistically compared. Significance is considered to exist when $P<0.05$.

Body weights. The percentage differences between the postoperative values of the body weights for each group of frogs designated in the legend under Fig. 1 and their respective preoperative values are plotted as functions of the postoperative time in days. The uncontrolled adrenalectomized frogs, unlike the three remaining groups, show a progressive increase in mean body weight so that by the seventh and twelfth days following adrenalectomy there is a significant increase of 28 and 33% respectively. Given sufficient time in an aqueous environment, the adrenalectomized frog undergoes a pronounced swelling [cf. Maes (1), p. 145]. This swelling is not only reflected in "un oedeme généralisé" but also in a cellular imbibition of fluid as shown macroscopically by the swollen, milky-white appearance of the myofibers of skeletal muscles. The progressive gain in body (water) weight becomes significant on the second day following adrenalectomy. This is interesting in light of the increased rate at which certain vital dyes and tagged ions penetrate adrenalectomized frog skin (2). That this increase is due to lack of the adrenocortical hormone and not to the localized kidney damage which tends to accompany cauterization is supported by studies on injury to this organ. Ordinarily the adrenal tissue can be "wiped" from the kidney by the convex side of a curved cautery needle. When "sham" operated frogs are damaged by longitudinally cauterizing both kidneys to a depth and width greater than necessary for removal of the adrenal, one finds no difference between the two groups of controls as regards

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[1] This investigation was partially supported by a grant in aid from the National Chapter, The Society of the Sigma Xi, and the Comly-Coleman Research Fund, The Ohio State University.

[2] I wish to thank Helena Angerer for her willing and valuable assistance.

the variables under discussion. Indeed, this was true even when both kidneys were deliberately split except for a segment a few mm. long at both poles which served to bind the lateral portion of the kidney to its medial mass. That this drastic procedure is apparently not deleterious to the frog is inferred from studies in which the ureters were bilaterally ligated (3).

Survival time. Sixty-seven per cent of the uncontrolled adrenalectomized frogs of the fall and winter stock when kept at room temperature (17°–22° C.) died between the seventh and twelfth days postoperatively. Studies on summer and early fall frogs support Maes' (1) findings that survival is reciprocally related to environmental temperature. Spring frogs do not survive adrenalectomy as well as frogs in other seasons, possibly due to a form of stress arising during the breeding season. Indeed, the adrenalectomized animal is abnormally sensitive to every type of stress (4).

To test whether the abnormal increase in water load of uncontrolled adrenalectomized frogs served to alter the death point, adrenalectomized frogs were kept over sphagnum moss wetted to a degree determined from the daily observation of individual body weights. In this way body weights were fairly well controlled (Fig. 1, cf. Adolph (5), p. 119). Cognizant of the susceptibility of adrenalectomized animals to many forms of stress, especially an increase (6, 7) or a decrease (8, 9) in water load, it was surprising that both groups of frogs showed essentially the same duration of survival following adrenalectomy. As a result of the latter studies (9) the conclusion is reached that the rate of water shift, or of change in osmotic pressure, is the more effective factor in this type of stress.

Coloration. The horizontal bar above the curves (Fig. 1) shows the mean postoperative time in days when an apparent darkening of the dorsal integument was observed in uncontrolled adrenalectomized frogs. The mean time for the appearance of integumental darkening is the end of the second day. Thereupon a succession of characteristic integumental color changes occurred in the following sequence: green, gray-green, gray-brown, gray, and black. Evidently Maes' (1) statement, "ce changement de pigmentation n' a pas été constant," needs revision, for adrenalectomized frogs given free access to water and sufficient time to accrue a water load showed the characteristic sequence of color change. Controlled adrenalectomized frogs darken, though not beyond the gray-brown (usually a gray-green) stage for comparable illumination and background. Darkening of the ventral integument occurs simultaneously but of course to a lesser degree than found on the dorsum. The cause of the color change is unknown though it is related to water load since controlled adrenalectomized frogs do not show blackening. Hence it is suggested that this characteristic color change is related to excessive water load which in some as yet unknown way affects the production of melanophore-dispersing hormone (intermedin) by the pituitary.

Skeletal muscle. Since it has been shown that there is a progressive increase in body weight of adrenalectomized frogs given free access to an aqueous environment and that part of this water is extracellular, it is of interest to compare the water content of skeletal muscles obtained from the four groups of frogs. Pairs of sartorius muscles were rapidly excised, blotted to remove excess water, and weighed with a torsion balance by the same person. The muscles were dried for 18–22 hours at 105° C. and dry weights were determined. The mean percentage of water content for sartorii of each group follows: uncontrolled (84.6 ± 0.4) and controlled (82.8 ± 0.4) adrenalectomized frogs and their controls, renal-damaged (82.8 ± 0.4) and unoperated (82.0 ± 0.8) frogs. A statistical comparison of the mean values of the first group of frogs with each of the remaining groups gives a decided significance ($P<0.01$).

Although sartorii from the uncontrolled adrenalectomized frogs have gained 1.8% in water content ($P<0.01$), the intact frog from which these muscles were excised showed a net gain of 23.1% in water content ($P<0.01$). Thus while the skeletal muscles intra- and extra-cellularly tend to absorb water after adrenalectomy the muscles are not the sole reservoir This is amply confirmed by the following observations When a water loaded uncontrolled adrenalectomized frog is pithed upon withdrawal of the needle there issues from the site of puncture, undoubtedly because of the pressure exerted manually in holding the frog a stream of fluid for a distance of *ca* 3 5 mm

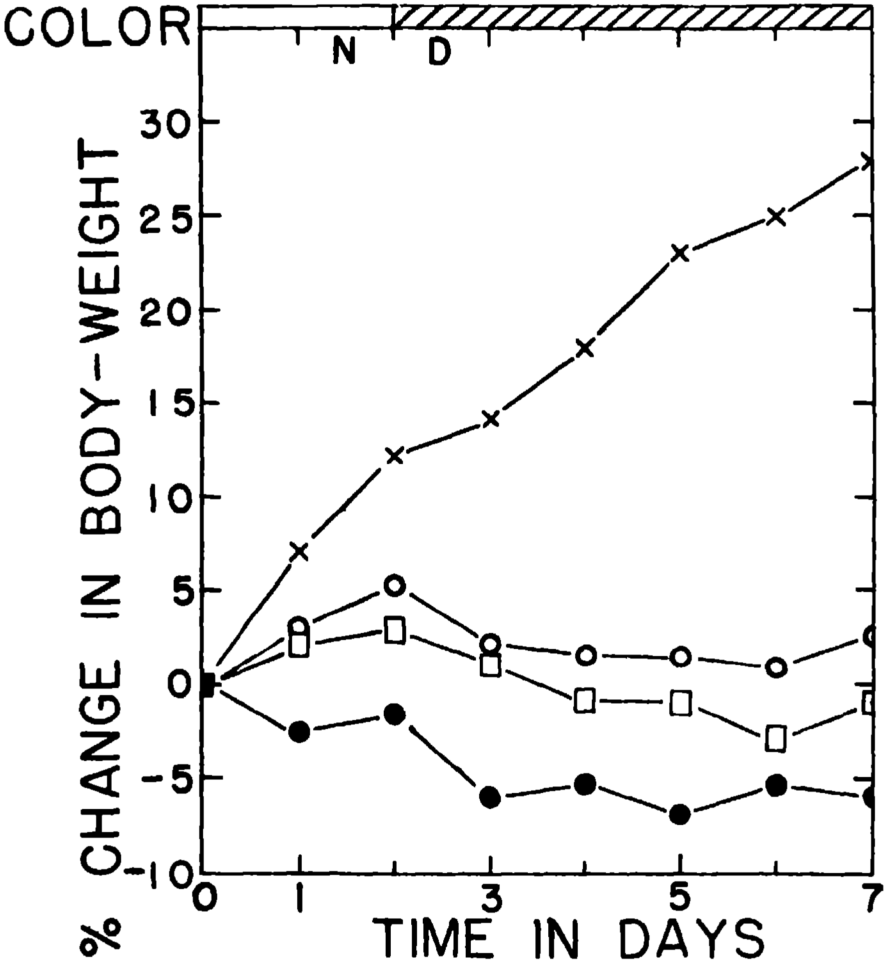

Fig 1 Percentage changes in body weight of 4 groups of frogs plotted as functions of time The groups are designated as follows the adrenalectomized frogs controlled (•) and uncontrolled (X) the control frogs—renal damaged (sham operated) (O) and unoperated (□) The terminations of the curves denote the mean death point for the respective groups the shaded area of the horizontal bar over the curves signifies the mean time (days) for the initial appearance and duration of integumental darkening (D) in uncontrolled adrenalectomized frogs as compared to normal (N) coloration

These results on frogs are in line with those on mammals (6) and show that the lack of adrenocortical hormone results in an imbalance in the distribution of body fluids with an accompanying increase in the water content of the liver and the eviscerated carcass of rats (9) of skeletal muscles of rats (11) and frogs (12) and of enucleated red cells of dogs (13) cats (14) and rats (15)

SUMMARY

From a study of slightly more than 1300 operated male grass frogs of which between 65% and 70% were adrenalectomized and the remainder were renal damaged (sham operated) the following conclusions may be drawn

1 Adrenalectomized frogs whose body weights are permitted to change *ad libitum* show a progressive increase in body weights when placed in a copious aqueous environment so that on the 7th and 12th days postoperatively there is a mean increase of 28% and 33% respectively

2 The mean rate of increase in water load and the total water load absorbed following adrenalectomy in the frog is a function within limits of the available water free to enter the integument from the external environment

3 At room temperature (17° 22° C) 67% of the adrenalectomized frogs die between the 7th and 12th days postoperatively

4 The duration of survival following adrenalectomy in the frog is independent of the total increase in water load Adrenalectomized frogs whose body weights were controlled to within ±1 5 g of their respective preoperative mean values for body weights showed the same survival time statistically as did adrenal ectomized frogs whose body weights were uncontrolled

5 As originally observed by Maes (1) these frogs showed integumental blackening after adrenalectomy but contrary to Maes observation blackening is not a sporadic occurrence It is a function of the total increase in water load following adrenalectomy for adrenalectomized frogs whose body water loads were controlled failed to show integumental blackening

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OHIO S STATUS AS A GAME AND FUR PRODUCING STATE CORRECTION

In the March 1950 issue of the OHIO JOURNAL OF SCIENCE I discovered the following errata in my article entitled Ohio as a Game and Fur Producing State ' On page 91 the last sentence under the heading of *Mourning dove* should appear as the second sentence under the heading *Bob white quail* Also under *Mourning dove* the third sentence should read Like the bobwhite however the dove as a game bird in Ohio was given protection from hunting 1913 to 1917 (rather than 1913 to 1947) and in the latter year was designated a song bird (Dambach 1948)

My name although spelled correctly under the title of the article page 88 had the middle initial J in it rather than the correct initial L at the top of pages 90 92 and 94 —*Daniel L Leedy*

NOTES ON THE CHEMICAL COMPOSITION OF PARTHIAN COINS WITH SPECIAL REFERENCE TO THE DRACHMS OF ORODES I[1]

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Over a thousand ancient coins of Greek and Roman origin have been assayed or analyzed, but only a few Parthian coins have been so investigated It might reasonably be expected, however, that the chemical investigation of the coins of the Parthian Empire would lead to results just as interesting as those that have been obtained from the chemical investigation of the coins of other ancient states Indeed, in view of our total lack of ancient literary information concerning the coins of this great eastern empire, it might be expected that the results of the chemical investigation of such coins would lead to results of relatively greater interest Furthermore, since the coins constitute the chief, and almost the only certain, archaeological remains of the Parthian Empire, any information that can be obtained from a chemical study of these coins will not only be a contribution to the obscure numismatic history of this empire but may be a contribution to its still more obscure economic history This paper contains a summary of what little has been done in the past on this subject, the results of chemical analyses of some Parthian silver and bronze coins, and interpretations of some of these results

PREVIOUS WORK

Prior to the present investigation only 16 Parthian coins appear to have been investigated chemically in any way, and these were all silver coins that were analyzed by fire assay for their silver and gold content only The results of these assays are shown in Table I

From these results it would seem evident that the earliest coins contain the highest proportions of silver, and that later coins, leaving out of consideration the one late tetradrachm, contain moderately high amounts There is no indication of any serious or progressive debasement in this series of Parthian drachms such as occurs in the series of denarii of the Roman Empire These results also indicate that individual coins of some rulers differ considerably from each other in silver content The proportions of gold in these coins, though high from the standpoint of modern silver coinage practice, are similar to those in the silver coins of many other ancient states In light of the results of the present investigation, certain of these conclusions, which seem so obvious from the results of previous work, are actually not valid

SOURCES AND IDENTIFICATION OF THE COINS

With the exception of six drachms of Orodes I, the coins analyzed in this investigation were purchased by the author from dealers here and abroad at various times The coins of Orodes I were presented to him for purposes of chemical study by Professor S H Weber, formerly Curator of Special Collections, Princeton University According to information supplied by Dr L C West, Curator of Coins and Medals, Princeton University Library, they came originally from a hoard of some 600 Parthian drachms accidentally dug up by a native worker in 1923 in a small village near Ahar, 75 miles northeast of Tabriz, Persia

The British Museum Catalogue of the Coins of Parthia, London, 1903, and

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[1] Presented in part at the meeting of the Ohio Academy of Science, Granville, Ohio, April, 1949

Head's Historia Numorum, Oxford, 1911, were used as the principal authorities for the identification of the coins that were analyzed, due consideration being given to the uncertainties that still exist as to the proper attribution and dating of certain of the coins

TABLE I

ASSAYS OF PARTHIAN SILVER COINS

No	RULER	DATE	FINENESS IN PARTS PER THOUSAND	
			Ag	Au
1	Tiridates I, or Arsaces, son of Tiridates I	248/247–211/210 B C 210–191 B C	946	
2	Mithradates I	171–138 (?) B C	923	2
3	Mithradates I	171–138 (?) B C	899	5
4	Mithradates I	171–138 (?) B C	892	2
5	Phraates II	138–128/127 B C	709	3
6	Artabanos II	88–77 B C	854	1
7	Artabanos II	88–77 B C	728	2
8	Tiridates II (?)	26 B C	611	2
9	Orodes II	4–6 A D	798	2
10	Orodes II	4–6 A D	622	3
11	Gotarzes	40/41–51 A D	805	3
12	Gotarzes	40/41–51 A D	755	2
13	Mithradates IV	130–147 (?) A D	749	4
14	Volagases III	185 A D	334	1
15	Volagases IV	191–207/208 A D	779	3
16	Artabanos V	213–227 (?) A D	746	4

NOTES TO TABLE I

a No 1 was assayed at the Prussian mint and the result was first published by A von Rauch in *Zeitschrift für Numismatik* 1, 37 (1874) This coin was attributed by von Rauch to Arsaces I probably on the basis of the inscription on it, but it is now believed that this ruler issued no coins On the assumption that the inscription was simply ΑΡΣΑΚΟΥ it is here attributed to one of the two rulers listed In spite of this uncertainty as to its exact attribution it is reasonably certain, at least, that this coin is the earliest in the series here listed

b The other coins were assayed at the Austrian mint and the results were first published by F Imhoff Blumer in his "Monnaies Grecques ' Amsterdam 1883 p 474 The attributions and dates are those given by B V Head in "Historia Numorum, Oxford 1911, pp 818–822 A question mark indicates some uncertainty in attribution or date

c All these coins were drachms except No 14 which was a tetradrachm This coin was attributed by Imhoff Blumer to Volagases IV, but since it bore the date 497 in the Seleucid Era, this places it in the reign of Volagases III according to the system of attribution at present generally accepted

ANALYSTS AND METHODS OF ANALYSIS

The six drachms of Orodes I were cleaned electrolytically before analysis and were analyzed by the author The other silver coins and the bronze coins were not so treated and were analyzed by Mr C D Oviatt under the direction of the author The author hereby thanks Mr Oviatt for his careful analytical work and the authorities of the Graduate School of the Ohio State University for a grant that enabled Mr Oviatt to do this work

Before being analyzed, the specific gravity of each of the silver coins was measured at 25° C/25° C by the method of Archimedes The coins were next filed smooth and the specific gravities of the blanks were also measured by the same method These blanks were then divided into samples of suitable size for analysis The specific gravities of the bronze coins were not measured, though samples were prepared for analysis in the same way

For the analysis of the silver coins, accurately weighed samples of about a gram were treated with nitric acid for the separation of gold and tin The ignited and weighed residue from the nitric acid treatment was extracted with cold, dilute aqua regia to dissolve the gold, and the resultant solution was diluted and treated with either ferrous sulfate or oxalic acid to precipitate the gold This gold was then collected on paper, ignited, and weighed By subtracting the weight of the gold from the weight of the residue, the weight of stannic oxide was obtained from which the weight of the tin was calculated In some experiments, as a check, the weight of the stannic oxide was also measured directly The filtrate from the separation of the gold and tin was treated with hydrochloric acid to precipitate the silver as chloride, this precipitate being collected in a filter crucible, dried, and weighed in the usual way The filtrate from the separation of the silver was treated with sulfuric acid, and the solution was evaporated until fumes of sulfur trioxide appeared After cooling, the residue was treated with water, and the lead sulfate was collected in a filter crucible, dried, and weighed Copper was determined by electrolysis in the filtrate from the separation of the lead, and from the small amount of lead dioxide collected on the anode and the previous weight of the lead sulfate, the total lead content was found The filtrate from the separation of the lead and copper was evaporated to small volume and treated with ammonium hydroxide solution to precipitate the iron, the precipitate being collected, ignited, and weighed in the usual way In the filtrate from the separation of the iron, nickel was precipitated with dimethylglyoxime and weighed in this form The filtrate from the separation of the nickel was treated to remove organic matter and examined for the presence of zinc with phosphate, the results being negative except for one coin which contained a sufficient amount for quantitative determination The coins were also examined for the presence of arsenic and sulfur, but the results were negative

The procedure for the analysis of the bronze coins was similar except that the steps for the determination of gold and silver were omitted, neither being found in appreciable amount in any of the coins Sulfur was found to be absent but arsenic was present in all but one For the determination of the arsenic a sample was first dissolved in concentrated nitric acid, the solution was evaporated to dryness, and the residue was baked to decompose the nitrates This baked residue was dissolved in concentrated hydrochloric acid, and the hydrochloric acid solution after adding ferrous sulfate, was distilled In the distillate, properly diluted, the arsenic was precipitated as arsenious sulfide with hydrogen sulfide This precipitate was collected in a filter crucible, washed first with water, next with carbon disulfide, and finally with ethyl alcohol, after which it was dried and weighed

This is merely an outline of the methods of analysis, many necessary manipulative details being omitted for the sake of brevity Where sufficient material was available, duplicate determinations were made The closeness of most of the summations to 100%, as shown in the tables of results, is an indication, at least, of the generally satisfactory nature of these methods and of the experimental manipulation

RESULTS OF MEASUREMENTS AND ANALYSES

The results of the specific gravity measurements are shown in Tables II, III, IV, and V The calculated figures for silver content from specific gravity shown in the second column of each of these tables are based upon the assumption that the silver in the coins was alloyed only with copper As shown by the chemical analyses (Table VI) this assumption is not correct, but copper is the usual and often the sole alloying metal in silver coins, and no other assumption appears possible in estimating the silver content of such coins from their specific gravities alone In making the calculations the specific gravity of pure silver was taken as 10 50 and that of pure copper as 8 90 The formula used for the calculations was

$$\% \text{ Silver} = \frac{S_1S_x - S_1S_2}{S_1S_x - S_2S_x} \quad 100$$

Where, on the same temperature basis for each,
S_1 is the specific gravity of pure silver
S_2 is the specific gravity of pure copper
S_x is the specific gravity of a given coin

This formula is based upon the ideal relationship between specific gravity and composition in a binary alloy in which no change in total volume of the components occurs on alloying Alloys of silver and copper fall in this class, and it has been shown experimentally that the silver content of modern coins may be closely approximated from their specific gravities.[3] No study appears to have been made before of the possibility of estimating the silver content of ancient coins from such measurements If applicable, this method of estimation would be very useful since ancient silver coins are often of such rarity and value that chemical analysis is not practicable However, because of the greater complexity of ancient

TABLE II

SPECIFIC GRAVITY AS AN INDEX OF SILVER CONTENT
GROUP I—UNTREATED COINS

Coin No	Specific Gravity	Silver Content from Specific Gravity	Silver Content by Analysis	Difference
		%	%	%
1	10 29	88 5	94 2	— 5 7
2	9 95	69 5	92 9	—23 4
3	10 09	77 5	90 6	- 13 1
4	9 84	62 5	76 9	—14 4
5	9 66	51 5	74 3	—22 8
6	9 92	67 5	73 4	— 5 9
7	9 59	47 0	67 9	—20 9
8	9 34	31 0	52 2	—21 2
				Ave = —15 9

TABLE III

SPECIFIC GRAVITY AS AN INDEX OF SILVER CONTENT
GROUP II—ELECTROLYTICALLY CLEANED COINS

Coin No	Specific Gravity	Silver Content from Specific Gravity	Silver Content by Analysis	Difference
		%	%	%
1	9 91	67 0	69 8	—2 8
2	9 73	56 0	58 2	—2 2
3	9 53	43 5	51 0	—7 5
4	9 48	40 0	47 3	—7 3
5	9 38	33 5	43 1	—9 6
6	9 42	36 0	41 8	—5 8
				Av = —5 9

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[3] Karmarsch, *Dinglers polytech J* 224, 565–573 (1877).

monetary silver and the possible presence of corrosion products on or in coins long buried in the ground, it might be expected that the method would be less certain than with modern coins.

Actually, as is shown in Tables II, III, IV, and V, large differences were found to exist between the silver content calculated from specific gravity and the silver content as determined afterwards by chemical analysis. These discrepancies are most marked in the results on the untreated coins (Table II). These low results can not be ascribed to any deposit of soil or to any crust of oxidation products of low specific gravity on the surfaces of the coins, as they were metallic in appearance and at the most were but slightly tarnished. It is likely that these coins, which were obtained from dealers, had been cleaned mechanically. However, as is shown in Table IV, considerably better agreement was found between the calculated silver content and the actual silver content of the cleaned blanks of these same coins. This seems to indicate that the surface layers of the coins contained porous metal as the result of selective removal of base metal during burial in the ground or that these layers contained corrosion products of low specific gravity as a result of intergranular corrosion. As shown by the results in Table III much better agreement was found between the calculated and actual silver content of coins of the same type that had been cleaned electrolytically, especially for the two having the highest silver content. Apparently this cleaning procedure not only reduces visible surface oxidation products but reduces also the intergranular corrosion products below the surface, and in effect consolidates the metal. From Table V

TABLE IV

SPECIFIC GRAVITY AS AN INDEX OF SILVER CONTENT
GROUP Ia—BLANKS OF UNTREATED COINS

Blank No	Specific Gravity	Silver Content from Specific Gravity	Silver Content by Analysis	Difference
		%	%	%
1	10.35	92.0	94.2	−2.2
2	10.14	80.5	92.9	−12.4
3	10.18	82.5	90.6	−8.1
4	10.05	75.0	76.9	−1.9
5	10.06	75.5	74.3	+1.2
6	10.09	77.5	73.3	+4.2
7	9.85	63.5	67.9	−4.4
8	9.63	49.5	52.2	−2.7
				Av = −3.3

TABLE V

SPECIFIC GRAVITY AS AN INDEX OF SILVER CONTENT
GROUP IIa—BLANKS OF CLEANED COINS

Blank No	Specific Gravity	Silver Content from Specific Gravity	Silver Content by Analysis	Difference
		%	%	%
1	9.97	70.5	69.8	+0.7
2	9.86	64.0	58.2	+5.8
3	9.78	59.0	51.0	+8.0
4	9.64	50.5	47.3	+3.2
5	9.57	46.0	43.1	+2.9
6	9.52	42.5	41.8	+0.7
				Av = +3.6

it will be seen that for the blanks of the electrolytically cleaned coins the silver content as calculated from the specific gravity was found to be actually higher than that found by analysis, which is another indication of the internal consolidation of the metal by electrolytic cleaning These higher results would be expected on compact metal of the composition found by analysis, by reason of the gold and lead present All these results seem to show that the estimation of the silver content of untreated ancient coins from their specific gravities is a very unreliable procedure, but that useful rough results may possibly be obtained by measurement of the specific gravities of electrolytically cleaned coins This whole question deserves extensive study

The results of the chemical analyses of the coins are shown in Table VI On comparing the percentages of silver given in this table with the figures for the fineness of Parthian drachms given in Table I some interesting similarities and differences are apparent Both groups of results indicate that only in the early coins of this Parthian series is the silver content of the coins really high, and that in most later coins it falls considerably below this high standard Though the figures of Table I indicate that it does not fall below 60%, the new results of Table VI shows clearly that it may fall nearly as low as 40% These new results are in direct contradiction to certain general statements that have been made in regard to the fineness of the Parthian silver coinage For example, Burns[*] states that the high initial standard continued with little alteration down to the end of the Parthian Empire in 227 A D However, as far as the present results show, the issue of really base silver drachms was confined to the reign of a single ruler, Orodes I of the period 57-38/37 B C It will be seen that in three of the six coins analyzed the silver content is below 50% The average silver content of the six is only 51 69% This is in marked contrast to the high silver content of 90 57% in a

TABLE VI

ANALYSES OF PARTHIAN SILVER COINS

Coin No	Ag %	Au %	Cu %	Sn %	Pb %	Fe %	Ni %	Zn %	Total %
1	94 17	0 11	5 02	0 26	0 37	0 05	0 05	none	100 03
2	92 86	0 30	5 81	0 08	0 85	0 04	0 03	none	99 97
3	67 88	0 27	29 33	1 54	0 92	0 04	none	none	99 98
4	90 57	0 27	8 36	0 08	0 63	0 03	none	none	99 94
5	69 77	0 42	27 74	0 75	1 15	0 02	0 02	0 10	99 97
6	58 19	0 53	37 29	1 26	2 65	0 02	0 03	none	99 97
7	50 97	0 35	43 97	2 35	2 34	0 03	0 02	none	100 03
8	47 29	0 43	49 10	1 83	1 41	trace	0 03	none	100 09
9	43 10	0 33	52 26	2 64	1 51	0 05	0 04	none	99 93
10	41 84	0 34	51 92	3 44	2 48	0 04	0 02	none	100 08
11	76 87	0 38	21 75	0 34	0 64	0 04	none	none	100 02
12	74 30	0 27	24 42	0 27	0 54	0 07	none	none	99 87
13	73 33	0 35	24 16	1 36	0 86	0 01	none	none	100 07
14	52 05	0 21	44 52	1 16	1 41	none	0 03	none	99 38

ATTRIBUTIONS AND DATES

Nos 1 and 2	Mithradates I	171-138 (?) B C
No 3	Sinatruces	77-70 B C
No 4	Phraates III (?)	70-57 B C
Nos 5 to 10 inclusive	Orodes I	57-38/37 B C
No 11	Gotarzes	40/41-51 A D
No 12	Vardanes I	41/42-45 A D
No 13	Volagases II	77/78-146/147 A D
No 14	Volagases V	207/208-221/222 (?) A D

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[*] Burns, A R Money and monetary policy in early times New York, 1927, p 164

coin (No 4 of Table VI) of an immediate predecessor of Orodes I and to the generally high silver content of the coins of all his predecessors Evidently a marked debasement of the silver coinage occurred during the reign of this ruler The fact that the silver content of the coins of Orodes I is spread over a considerable range is not only a sign of debasement but is a sign of progressive debasement during his reign It is obvious, as a general rule, that when no debasement occurs during the reign of a ruler his individual coins selected at random will not only be of high standard but will differ little from each other in fineness, but that if debasement of the coinage begins and continues during a reign such individual coins will differ considerably from each other in silver content Some illustrative data are shown in Table VII This table is derived from Tables I and VI, and shows the range of silver content and average silver content of all Parthian silver coins of which two or more of a given ruler have now been assayed or analyzed It is not claimed that these figures are very reliable since so few individual coins of each ruler have been analyzed The data based upon only two determinations are especially open to question However, these are the only such figures possible at present, and they at least appear to give significant indications It will be seen that the percentages of silver in the five coins of Mithradates I range over only 5%, whereas in the six coins of Orodes I they range over 28% Then in the three coins of Gotarzes the range is again only 5%, with the coins of the other two rulers in intermediate positions In the group as a whole a consistent inverse relationship exists between range and fineness Apparently the debasement of the coinage during the reign of Orodes I was followed by considerable improvement during the reigns of the succeeding rulers, though the original high standard was never again restored

TABLE VII

RANGE OF SILVER CONTENT AND AVERAGE SILVER CONTENT OF COINS OF CERTAIN PARTHIAN RULERS

Ruler	Date	No of Coins	Range in Silver Content %	Average Silver Content %
Mithradates I	171–138 (?) B C	5	5 0	91 7
Artabanos II	88–77 B C	2	12 6	79 1
Orodes I	57–38/37 B C	6	28 0	51 7
Orodes II	4–6 A D	2	17 6	71 0
Gotarzes	40/41–51 A D	3	5 0	77 6

The percentages of gold shown in Table VI are in approximate agreement with the fineness figures of Table I In the analyses of Table VI the average percentage of gold is 0 33, and in the assays of Table I the average gold content in terms of percentage is 0 25 There is a greater discrepancy in the ratios of gold to silver in the results of the two tables, but this lack of exact agreement may be ascribed to the difference in the methods of determining the gold It is likely that the present results are more accurate As compared to those of modern silver, the proportions of gold in Parthian coinage silver are very high, but such proportions of gold are characteristic of ancient silver in general The gold in the Parthian coinage silver was evidently present as a mere fortuitous impurity that accompanied the silver, and it varied considerably in proportion in accordance with the source of the silver and the details of its metallurgical treatment It seems improbable that ancient metallurgists had any means of separating these small proportions of gold from silver, or that they were even aware that their silver contained gold in such proportions

As the figures of Table VI show, copper is the main alloying component of Parthian coinage silver That it was introduced into the alloy as the metal itself is very improbable as will appear from a consideration of the proportions of tin and lead in the coins

Though the percentages of tin are not very high numerically, being above 3% in only one coin, they are nevertheless very high for ancient silver They are generally higher in the debased silver coins of Orodes I than in the other coins that were analyzed, especially the earlier coins of high silver content Tin, when not absent entirely, is usually present in ancient coinage silver to the extent of only a few hundredths or tenths of a percent In a series of sixteen ancient Greek silver coins analyzed by Bibra,[4] three were found to contain a trace of tin, the others none, and in a series of twenty-two Roman Imperial silver coins, many of them debased, which were analyzed by this same investigator, tin was either absent or present as a mere trace in eleven, the highest proportion found being 0 71% and the average only 0 13% The analyses in Table VIII show his results on coins having about the same range of silver content as the coins of Orodes I According to the analyses of Bibra, tin is likely to be absent especially from coins of very high silver content This appears to be confirmed by some more recent analyses by Elam[5] which are shown in Table IX Apparently tin was absent from all these coins of very high fineness, or else the analyst did not think it worth while to determine the small amounts that could have been present The absence of tin from all such coins is what might be expected from its usual absence from deposits of silver ores In general, then, tin is not normally associated with the silver of ancient coinage alloys, and there is no reason to believe that the Parthian coinage alloys were exceptional in this respect It seems very probable, therefore, that most of the tin in the Parthian alloys was introduced along with the copper

TABLE VIII

ANALYSES OF GREEK AND ROMAN SILVER COINS SIMILAR TO THE COINS OF ORODES I IN FINENESS

Ag %	Au %	Cu %	Sn %	Pb %	Fe %	Ni %
73 96	0 25	23 94	none	1 35	trace	none
56 76	1 81	40 63	none	0 75	0 23	trace
54 92	0 15	43 80	0 20	0 75	0 11	0 07
43 97	0 10	55 26	0 21	0 31	trace	0 15
43 41	0 72	54 69	none	trace	0 97	0 21
40 66	0 17	58 70	0 10	0 13	0 24	none

TABLE IX

ANALYSES OF GREEK SILVER COINS OF VERY HIGH FINENESS

Ag %	Au %	Cu %	Pb %	Fe %	Ni %
99 40	trace	none	0 46	trace	none
99 19	0 44	none	0 13	trace	none
99 09	trace	none	0 40	trace	none
99 07	trace	trace	0 43	trace	none
98 98	0 003	none	0 63	trace	none

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[4] Bibra, E von Ueber alte Eisen und Silber-Funde Nurnberg and Leipzig, 1873, pp 37, 40

[5] Elam, C F *J Inst Metals* 45, 57-69 (1931)

Similarly, the percentages of lead shown in the analyses of Table VI, especially in the coins of Orodes I, are unusually high for ancient coinage silver, as may be seen by comparing these percentages with those shown in Tables VIII and IX All these percentages are further compared in Table X, where it will be seen to what extent the proportions of lead in the coins of Orodes I are abnormally high Evidently a fairly constant small proportion of lead is almost always present in ancient fine silver, apparently as a residue from the imperfect cupellation of argentiferous lead, but the proportions of lead in the debased coins of Orodes I are so abnormally high that it seems necessary to conclude that only part of this lead was introduced into the alloy along with the silver and that the rest was introduced along with the copper

The small percentages of iron shown in the analyses of Table VI are probably without much significance, as iron is almost a universal accidental impurity in ancient metals and alloys However, as shown by the analyses of Table IX the iron content of ancient silver coins of very high fineness is usually very small, so that it might well be that the noticeably larger proportions found in these Parthian coins were introduced into the alloys along with the copper rather than with the silver It is still more likely that the small proportions of nickel shown in the analyses of Table VI were introduced with the copper rather than the silver In these analyses nickel is invariably present in the coins of very high copper content (over 35%) but absent from more than half the others Furthermore, the analyses cited in Table IX indicate that nickel is not normally associated with ancient silver, and this same lack of association is apparent from other analyses of ancient silver coins of high fineness The small proportion of zinc found in one coin (No 5) is in all probability a mere accidental impurity that was introduced along with the copper Neither arsenic nor sulfur in weighable amounts was found in any of these silver coins

TABLE X

COMPARISON OF COINS OF ORODES I WITH EARLIER PARTHIAN COINS AND WITH CERTAIN GREEK AND ROMAN COINS IN RESPECT TO SILVER CONTENT, LEAD CONTENT, AND RATIO OF LEAD CONTENT TO SILVER CONTENT

GROUP	Ag %	Pb %	Ratio of Pb to Ag
Parthian Coins Prior to Orodes I	Max = 94 17 Min = 67 88 Av = 86 37	Max = 0 92 Min = 0 37 Av = 0 69	Max = 0 014 Min = 0 004 Av = 0 008
Coins of Orodes I	Max = 69 77 Min = 41 84 Av = 51 69	Max = 2 65 Min = 1 15 Av = 1 92	Max = 0 059 Min = 0 016 Av = 0 039
Greek and Roman Coins of Similar Fineness	Max = 73 96 Min = 40 66 Av = 52 28	Max = 1 85 Min = trace Av = 0 63	Max = 0 025 Min = 0 000 Av = 0 010
Greek Coins of Very High Fineness	Max = 99 40 Min = 98 98 Av = 99 14	Max = 0 63 Min = 0 13 Av = 0 41	Max = 0 006 Min = 0 001 Av = 0 004

The results of the analyses of the bronze coins are shown in Table XI These are apparently the first analyses of any kind of a Parthian bronze object that have been reported It will be seen that the two earliest coins are very similar to each other in composition, and that the two coins of Orodes I are also very similar to each other Larger differences exist in the composition of the two coins of Sinatruces, but they are similar to each other in the proportions of lead they contain, and their lead content clearly groups them together as distinctly different from the earlier and the later coins. These similarities in the composition of coins issued in the same reign seem to indicate the existence of at least some standardization and control in the preparation of the bronze coinage alloys.

Though these coins viewed as a whole are not very different in composition except in lead content, this one difference is very marked. The relationships of the proportions of the main components of the alloys to each other are perhaps more readily evident from the ratios of the percentages, shown in Table XII, than from the percentages themselves. For the coins of Sinatruces and of Orodes I these ratios were calculated from the average percentage figures for each pair of coins. It will be seen that in the two earliest coins the ratios of the components are essentially the same, and that in the group as a whole there is little change in the ratio of tin content to copper content. The most striking and significant fact is the progressive increase in the ratios of lead content to copper content and of lead content to tin content. This same sort of chronological change in these ratios, with the ratio of tin content to copper content remaining relatively constant, has been previously observed in various series of Greek bronze coins, and has been explained as being the result of the remelting of old worn bronze coins of previous issue with lead in order to obtain metal for the issue of new coins.[6] However, the lead content of these Parthian coins is generally lower than that of contemporaneous bronze coins issued elsewhere in the ancient world, even in localities near Parthia. This is illustrated by the analyses listed in Table XIII of a series of coins struck in Syria.[7] In this one respect, at least, Parthian bronze coins of the period covered by the analyses have a composition that is distinctive.

TABLE XI

ANALYSES OF PARTHIAN BRONZE COINS

No.	Cu %	Sn %	Pb %	Fe %	Ni %	As %	Total %
1	88.64	6.72	3.88	0.15	0.07	0.26	99.72
2	89.54	6.97	3.18	0.09	0.08	0.11	99.97
3	88.31	4.71	6.60	0.08	0.18	0.05	99.94
4	83.90	7.24	8.54	0.04	0.07	none	99.79
5	82.19	5.17	12.03	0.08	0.10	0.24	99.81
6	80.69	6.08	12.65	0.04	0.08	0.21	99.79

ATTRIBUTIONS AND DATES

No. 1 Mithradates I 171–138 (?) B.C.
No. 2 Mithradates II 123–88 B.C.
Nos. 3 and 4 Sinatruces 77–70 B.C.
Nos. 5 and 6 Orodes I 57–38/37 B.C.

TABLE XII

RATIOS OF MAIN COMPONENTS IN PARTHIAN BRONZE COINS

Period B.C.	Ratio of Sn to Cu	Ratio of Pb to Cu	Ratio of Pb to Sn
171–138 (?)	0.08	0.04	0.6
123–88	0.08	0.04	0.5
77–70	0.07	0.09	1.3
57–38/37	0.07	0.15	2.2

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[6] Caley, E. R. The Composition of Ancient Greek Bronze Coins. Philadelphia, 1939.

[7] From Table XVIII, pp. 92–98 of the work cited in Reference 6.

The percentages of the various impurities listed in Table XI are similar to those generally found in ancient coinage bronze The nickel content is noticeably higher than in most ancient coinage bronze of the same period, and this may be of some significance as a distinctive characteristic Though there appears to be some systematic variation in the arsenic content from one reign to another, this is probably fortuitous, as the arsenic content of ancient coinage bronze, like the iron content, usually varies in an erratic manner, thus indicating that both are mere accidental impurities Neither zinc nor sulfur, often present in ancient coinage bronze, was found in any of these Parthian coins

THEORY OF DEBASEMENT OF THE DRACHMS OF ORODES I

In the preceding discussion of the analytical results it was shown that nearly all the tin, iron, nickel, and part of the lead, were introduced, in all probability, into the debased silver coins of Orodes I along with the copper Such a mixture in the approximate proportions indicated by the analyses would constitute a bronze Consequently, it may logically be inferred that the debased coinage silver of Orodes I was manufactured by alloying silver of good quality with bronze Furthermore, the composition of this bronze could be calculated closely from the results of Table VI providing the composition of this silver were known Though there seems to be no way to find out the exact composition of this silver, certain plausible assumptions as to its composition may be made These are A That it was fine silver of the highest quality known in the ancient period, and that its composition was about the average of the analyses shown in Table IX B That it was Parthian coinage silver of high quality obtained by melting together worn coins of earlier reigns, and that its composition was about that of the average of the analyses of Coins 1, 2, and 4 of Table VI C That it was Parthian coinage silver of high quality produced mostly by melting down coins of the reign immediately preceding that of Orodes I, and that its composition was about that of Coin No 4 of Table VI In view of the usual practice in mints, assumptions B and C seem more likely than A, and possibly C is more likely than B Shown in Table XIV are the results of calculations, based on these three assumptions, of the probable composition of the bronze used in producing the coinage alloy for each of the six coins of Orodes I In making these calculations the gold was counted with the silver and no allowance was made for preferential loss of components of the bronze by

TABLE XIII

ANALYSES OF SYRIAN BRONZE COINS

No	Cu %	Sn %	Pb %	Fe %	Ni %	Zn %	As %	S %	Total %
1	88 72	8 54	2 56	0 11	0 04	none	0 04	0 02	100 03
2	90 80	6 52	2 25	0 29	0 02	none	0 02	0 01	99 91
3	80 12	6 18	13 12	0 01	0 03	0 05	0 26	0 17	99 94
4	80 84	5 94	11 84	0 01	0 07	0 03	1 32	none	100 05
5	64 32	4 07	31 70	0 01	none	none	trace	0 01	100 11
6	67 13	7 62	24 90	0 14	0 02	0 01	0 10	none	99 92

ATTRIBUTIONS AND DATES

No 1	Antiochus II	261–246 B C
No 2	Antiochus III	222–187 B C
No 3	Seleucus IV	187–175 B C
No 4	Demetrius II	146–138 B C
No 5	Antiochus VIII	121 B C
No 6	Antiochus VIII	114 B C

oxidation or volatilization during the melting of it with the silver Actually, the calculated figures would not have differed materially if allowance had been made for various small losses that could have occurred in this way It will be seen that the three sets of figures for each coin are similar to each other, in the proportions of the main components at least, regardless of which assumption is made as to the composition of the silver that was debased Hence the exact composition of this silver is not a matter of great importance for estimating the essential composition of this bronze In general, as shown by the closer absolute and relative correspondence of the figures based on the three assumptions, the greater the degree of debasement the less the importance of the exact composition of the silver Though there are considerable differences in the calculated compositions of the bronze used in the manufacture of the alloys for the individual coins, these compositions viewed as a whole are not radically different Because of the lesser importance of the exact composition of the silver, and the greater accuracy of the computations, especially as regards the figures for the minor components, the figures calculated for Coins 9 and 10 are probably more reliable than the others The average figures for these two coins, shown at the bottom of Table XIV, may be taken as representative of the probable composition of the bronze that was used in producing the debased silver drachms of Orodes I

TABLE XIV

PROBABLE COMPOSITION OF THE BRONZE USED IN DEBASING THE COINS OF ORODES I CALCULATED ON THREE POSSIBLE ASSUMPTIONS AS TO THE COMPOSITION OF THE ALLOY THAT WAS DEBASED

Coin No	Assumption	Cu %	Sn %	Pb %	Fe %	Ni %
5	A	94 63	2 55	2 68	0 07	0 07
	B	94 57	2 63	2 80	none	none
	C	93 98	3 03	2 90	none	0 09
6	A	90 93	3 07	5 88	0 05	0 07
	B	90 62	3 19	6 16	none	0 03
	C	90 16	3 42	6 33	none	0 09
7	A	90 66	4 85	4 39	0 06	0 04
	B	90 43	5 08	4 47	0 02	none
	C	90 10	5 28	4 55	0 02	0 05
8	A	94 11	3 51	2 32	none	0 06
	B	94 12	3 62	2 22	none	0 04
	C	93 91	3 76	2 27	none	0 06
9	A	92 79	4 69	2 36	0 09	0 07
	B	92 73	4 86	2 29	0 06	0 06
	C	92 54	4 98	2 32	0 08	0 08
10	A	89 94	5 96	4 00	0 07	0 03
	B	80 72	6 19	4 03	0 04	0 02
	C	89 49	6 33	4 08	0 06	0 04
All	Max	94 63	6 33	6 33	0 00	0 09
	Min	89 49	2 55	2 22	none	none
	Av	91 97	4 28	3 67	0 03	0 05
9 and 10 only	Max	92 79	6 33	4 08	0 09	0 08
	Min	89 49	4 69	2 29	0 04	0 02
	Av	91 20	5 50	3 18	0 07	0 05

The source of this bronze may have been earlier Parthian bronze coins It seems significant that the average figures calculated for Coins 9 and 10 are similar to the analytical figures for the bronze coins of Mithradates I and Mithradates II given in Table XI Bronze of the composition of the bronze coins of Orodes I, either in the form of the coins of this ruler or in the form of bulk metal, evidently was not used in producing his debased silver coins Furthermore it is improbable that bronze having the composition of the bronze coins of Sinatruces, or bronze coins of this ruler, could have been used for the purpose Only one principal qualitative discrepancy exists between the calculated composition of the bronze used for debasing the silver coins of Orodes I and the analytical figures for the two early Parthian bronze coins This is the presence of arsenic in these coins However, it is entirely possible that the arsenic in the bronze coins was completely oxidized and volatilized on remelting and that as a consequence none was incorporated in the debased silver

That bronze in the form of coins, rather than in any other form, was used in debasing silver for the production of the drachms of Orodes I is probable It is the usual practice in mints to obtain most of the metal for the issue of new coins by melting down earlier ones, especially if these are worn, and at the time of Orodes I it is almost certain that most of the bronze coins of Mithradates I and Mithradates II still in circulation were in poor condition Furthermore, the bronze coins of these two rulers are of larger diameter and greater weight than the bronze coins issued by later rulers, and this could have been an additional reason for withdrawing these particular coins from circulation and using them as a source of metal

TABLE XV

CORRELATION BETWEEN ANALYTICAL FIGURES ON COMPOSITION OF DEBASED SILVER COINS OF ORODES I AND THEORETICAL FIGURES

Coin No	Source of Figures	Ag %	Au %	Cu %	Sn %	Pb %	Fe %	Ni %
9	Analysis	43 10	0 33	52 26	2 64	1 51	0 05	0 04
	Calculation	43 10	0 13	51 32	3 32	1 99	0 07	0 04
10	Analysis	41 84	0 34	51 92	3 44	2 48	0 04	0 02
	Calculation	41 84	0 13	52 45	3 41	2 03	0 07	0 04

In Table XV are shown the results of calculations on the composition of the debased silver that could have been produced by melting bronze of the average composition of the coins of Mithradates I and Mithradates II with silver of the composition of Coin 4 of Table VI to produce alloys having the silver content of Coins 9 and 10 of Table VI In making these calculations it was assumed that all the arsenic was volatilized from the bronze, and an allowance was made for a loss of 10% of the tin and lead by preferential oxidation in the process of remelting and alloying The degree of debasement for Coin 9 is 52 41% and for Coin 10, 53 80% It will be seen that there is substantial agreement between the actual and the theoretical figures On the whole, therefore, it does not appear at all unlikely that the metal for the debased drachms of Orodes I was made by melting down silver coins of his immediate predecessor, or more than one predecessor, with early Parthian bronze coins

On the basis of present knowledge, serious debasement in the long series of drachms issued by the rulers of Parthia occurred only during the reign of Orodes I Though such causes as the dishonesty of mint officials, a series of internal economic crises, or the effect of monetary changes in other countries may account for this debasement, no historical evidence in support of any such causes appears to exist The real cause may have been military conflict between the Parthian and Roman empires, which not only first occurred during the reign of Orodes I but occurred repeatedly during his reign[8] Analogous conflicts, both in ancient and modern times, have often resulted in the debasement of the coins of at least one of the combatants The prolonged warfare between the Parthians and the Romans during his reign may have led to a need for a greatly expanded coinage or have caused other economic changes that made debasement of the coinage a necessary consequence Moreover, it seems significant in support of this as a fundamental cause that the end of this warfare coincided with the end of the reign of Orodes I and that after his reign there was an era of peace between the two empires that lasted nearly a century If the debasement of the coins was caused directly or indirectly by this warfare, the rise in the fineness of the coins of the successors of Orodes I may plausibly be explained by the succeeding long period of peace Though the Parthians were later engaged in other warfare with the Romans, and probably fought other peoples at various times, these other conflicts may not have been on such a scale as to affect seriously the economy of the Parthian Empire, and for that reason did not lead to the debasement of the coinage Generally speaking, the debasement of a coinage is often an index of warfare so intense or prolonged that the economy of a country is seriously altered In conclusion, therefore, it does not seem improbable that the fundamental cause of the debasement of the coins of Orodes I was the warfare known to have occurred between the Parthian Empire and the Roman Empire during the reign of this ruler

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[8] Sykes, Sir P A History of Persia London 1930, Vol I, pp 346–359

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HEALTH CONDITIONS IN THE MORAVIAN INDIAN MISSION OF SCHÖNBRUNN, IN THE 1770's[1]

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In May, 1772, on a plateau above, and quite near to, the Tuscarawas River, in eastern Ohio, there was founded the Moravian Indian Mission of Schönbrunn by the well known Missionaries, David Zeisberger and John Heckewelder They were accompanied and competently advised by the Rev John Ettwein, a man with an unusual gift of organization They had moved to the new mission site on the Tuscarawas from Langundo-Utenünk (*Friedensstadt*), a short-lived mission settlement on the Big Beaver, in northwestern Pennsylvania, at the express invitation of the Lenni Lenape king, Netawatwes, who desired to have the wholesome influence and example of a Moravian mission community as near as possible to its capital town of Gekelemukpechünk (Newcomerstown), where to his growing dismay the excessive use of liquor had been increasingly corrupting the physical and moral fibre of men and women alike

Close to the beginning of the first of the Mission Diaries from Schönbrunn, such as were dispatched at regular intervals to the mother church, at Bethlehem, Pennsylvania, David Zeisberger remarks about a family of ten postulants for admission to the Moravian community that "in externals" they were "very poor, and sickly besides, as the Indians generally are when they come to us, until they have learned to live in a well regulated manner" (1) In part, the physical misery of this particular family may have been caused by the famine widespread, according to ample documentary evidence, among the Indians, in 1772 Zeisberger's remark, however, that the Indians, generally, were impoverished and sickly when they came to the Moravian missions, is obviously based on experience gained *prior* to his coming to Ohio, or he could not have known as yet that their condition improved, once that "they have learned to live in a well regulated manner," that is, under Moravian mission discipline After mentioning their lack of physical endurance in "agricultural or other manual labour," John Heckewelder (2) confirms Zeisberger's observation in the following words

> "Those who have been brought up to regular labour, like ourselves, become robust and strong and enjoy good health Such was the case with the Christian Indians in the Moravian settlements"

This statement follows a paragraph in which he calls "the Indians in general a strong race of men" capable of carrying record loads for hours and over great distances The two examples, however, which he cites for it, suggest observations made in mission environment

From the evidence cited, and from some more here not adduced, it appears that, to a great extent, the Indian population of the Moravian missions was made up of people who sought the missions in a condition of despondency, economical and physical rather than spiritual, yet, there are outstanding cases on record, in which the converts had been in no distress whatsoever, economical or otherwise Since the rate of recovery, as a result of mission life, apparently was very high, there is good reason to assert that the Moravian mission atmosphere made for better health conditions than those in the surrounding heathen area Zeisberger's and Heckewelder's mission diaries and other writings contain the data

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[1] Paper read before the Anthropology Section of The Ohio Academy of Science at the annual meeting, in April, 1949, at Granville, Ohio It reports part of the research work done by Dr Mahr for The Ohio State Archaeological and Historical Society in connection with the restoration of the Moravian Mission town of Schönbrunn The Society contemplates a detailed publication of these studies when completed

They also show that the locality of Schönbrunn was far from being a health resort, despite the excellent drinking water from the Beautiful Spring, despite its fertile soil, and despite its favorable geographic situation, in general Whoever knows the Schönbrunn scene understands why it was badly infested with fevers At the very foot of the Schönbrunn plateau there was the lagoon, a swampy meander loop of the Tusacarawas River It was the ideal breeding place of a merry assortment of mosquitoes, including the genus Anopheles some species of which are notorious as the transmitters of certain types of malaria In fact, the mosquitoes hatch, in the lagoon, even today, although the disease itself has disappeared for quite some time from the Tuscarawas and Muskingum valleys In the 1770's, however malaria was one of the scourges of both whites and Indians, at Schönbrunn, while Gnadenhutten, likewise founded in 1772 about ten miles downstream from Schönbrunn, but in a less swampy area, had little malaria With the exception of one entry (Oct 22, '73), the Gnadenhütten mission diaries, when referring to malaria, tell of repeated incidences, even of epidemic character at Schonbrunn and so, of course, do the Schönbrunn diaries

Zeisberger (3) writes about the mosquitoes at Schönbrunn that they "are found in woods in summer time in great numbers," they "sting, and a night in the forest would be intolerable without the smoke of a fire They are particularly annoying in changeable weather" Superfluous to say, this was written with no reference to malaria, the dependence of which on transmission by mosquitoes was not discovered until late in the 19th century Up to that time, it was commonly held that the so-called miasmatic air in certain swampy regions, such as Schönbrunn, caused these fevers whose periodic incidence had long been known but could not be explained

All malaria attacks recorded in the mission diaries fall within the months of July, August, September, and October Under September 28, 1772 (4), Zeisberger writes, as follows

> "Many of our people [that is, Indian converts, *ACM*] have suffered attacks of fever, which is very common here at this time of the year"

1773 was an especially bad fever year On August 18, 1773 (5), Br Schmick, the Missionary at Gnadenhutten, makes this entry

> '[We] left by water for Schönbrunn, where we found Sr Jungmann in bed suffering from chills and her husband still fagged out and weak from having had the same sickness"

Under August 19, he continues, as follows

> " we visited the Brethren and Sisters [the converts] there [at Schonbrunn] in their houses and cabins and found many who had chills"

Still referring to Schönbrunn, Schmick writes, under September 21 (6) "Br John Jungmann had another attack of fever," and, on September 22

> "This evening, Br Jungmann suffered an attack of chills Bathseba [an Indian convert, *ACM*] prepared at once some ***Beson*** (usually a concoction made of herbs and/or roots) or medicine for him to drink, which he took gladly"

Br and Sr Jungmann, the Missionary couple at Schonbrunn, each had a very bad case of it [1]) Under September 30, 1775, Zeisberger made this entry in the Schönbrunn Diary (7)

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[1] According to *SD 5* (July 24 73) Jungmann must have contracted the fever early in July, 1773 On September 1, he is reported to have "quite recovered from his fever", a recovery, by the way which did not last very long In the same entry, the Diarist remarks that, "since yesterday,' August 31 'his wife likewise has been in bed with fever"

> " Br Jungmann, who has had fever for some time, has become worse and was obliged to take to his bed, "

Zeisberger's entry of October 22, 1775 (8) contains the interesting statement, that

> "Sr Jungman has for quite some time been suffering of three-day fever "

That clearly marks her case as a tertian malaria (***Plasmodium vivax***) in which the gametocytes erupt from the red corpuscles every 48 hours Zeisberger adds that she "had severe pains in the side today," indicating that either her spleen or liver, or both, had become affected

> "After blood-letting," he concludes, "and application of medicinal remedies, she improved during the following days, the fever left her and she was quite restored "

Her husband's case, who, in 1773, is on record of having suffered attacks only one or two days apart (September 19, 21, 22), may have been a case of sub-tertian malaria (***Plasmodium falciparum***) characterized by more frequent, irregularly spaced attacks, or it may have been a case of a double infection, on two successive days, with ***Pl vivax*** Dr Ernest Carroll Faust[a]) has expressed himself in support of this latter possibility, adding the following remark

> "Actually we know that under controlled conditions of experimental vivax infection in man there is at times a daily episode of chills and fever, the so-called 'malaria duplicata' "

Finally, there is a remote possibility of Jungmann's case having been a mixed infection by ***Pl vivax***, causing tertian fever, and ***Pl malariae***, quartan fever, when overlapping, the result may be daily, or irregularly spaced, attacks such as in sub-tertian malaria Dr Faust states that ***Pl malariae***

> "may have conceivably been present in the Muskingum Basin at that time, although the distribution of this malaria parasite in the United States within the last 50 years or more has been south of the Ohio River "

On the assumption that the mosquito population of the region has not substantially changed since the 1770's, there are two species of ***Anopheles*** to be considered as probable transmitting agents of malaria at that time ***Anopheles punctipennis*** Say, and ***A quadrimaculatus*** Say (8a) Dr Faust gives the following opinion

> "Although ***Anopheles punctipennis*** has been found infected in nature, it is much less anthropophilic than ***A quadrimaculatus*** Since the latter species has in recent years been present in Ohio, it is likely that it occurred in the same area in the 1770's Therefore it seems probable that the major part of malaria in those days may justly be attributed to the species ***quadrimaculatus*** "

According to Heckewelder (9), the aboriginal remedies applied in the treatment of "fevers" were, internally, emetics, and, externally, bleeding and sweating There is ample evidence that the Moravian Missionaries freely and gladly made use of the medical lore of their converts, no less than did the Indians themselves, and with satisfactory results, at that The Indian method of bleeding, such as practiced on Mrs Jungmann, is described by Zeisberger (10), probably from personal experience, in the following words

> "For blood-letting they use flint or glass Of either they break off little fragments until a piece is secured that suits the purpose This is fixed to

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[a] In a personal letter of May 17 1949 I have received invaluable information on this particular problem from Dr Faust, The William Vincent Professor of Tropical Diseases and Hygiene and Head of the Division of Parasitology, Department of Tropical Medicine and Public Health in the School of Medicine, The Tulane University of Louisiana, at New Orleans My sincere thanks go to Dr Faust for his gracious assistance —*A CM*

> a short stick, placed upon the artery and struck In case of cupping, they open the skin with a knife, put a little calabash over the opening, burning birchbast instead of a lamp"

The Lenni Lenape's method of therapeutical sweating will be discussed below (p 128)

The only step taken by Zeisberger and his Moravian associates toward combatting the fevers was a wise preventive measure Under date of January 2, 1776, Zeisberger writes in the Schonbrunn Diary (11)

> "Upon deliberation with the [Indian] helper Brethren we resolved to lead water from the Muskingum [the Tuscarawas, *ACM*] into the little lake [the meander lagoon, *ACM*] near our spring so that, in the summer time, we may not have stagnant water but a flowing stream beside our Town, which, as we hope, will not only be conducive to the health of the place but also bring various conveniences with it We can do this without much trouble and labor if we dig a ditch about thirty rods in length On the 4th [of January], the Brethren made a beginning completing the task in a few days, as far as the water will now permit the rest of the work must be left until warm weather comes"

If that had been done sooner it might have prevented the hatching of millions of mosquitoes and through it, many a case of malaria As it was, the settlement could benefit from it for only fifteen months, since in April, 1777 under the duress of the Revolutionary War, Schonbrunn had to be abandoned and was subsequently destroyed

In regard to another serious endemic affliction of the Ohio Lenni Lenape in the 1770's namely, pulmonary tuberculosis, called *Schwindsucht* (consumption) in the mission diaries the Schonbrunn Indian community appears to have fared very well No more than two cases are on record in the Schonbrunn Diaries both of them youths who died at the Mission the one (12) in 1773 had 'been suffering from consumption for a year," and the other (13) "was baptized and "died December 10 1775 'He came to us suffering from consumption ' the diarist explains

Heckewelder (14) offers the following aetiological comment

> "Consumptions are very frequent among them since they have become fond of spiritous liquors, and their young men in great numbers fall victims to that complaint A person who resides among them may easily observe the frightful decrease of their numbers from one period of ten years to another '

These lines were obviously written many years after Heckewelder's sojourn at Schönbrunn, yet, as early as 1772 he had made his basic observations in that same year, the Rev David McClure (15) had occasion to witness an alcoholic orgy at Gekelemukpechunk, the Lenni Lenape capital

Heckewelder correctly established an aetiological connection between alcoholic excesses and pulmonary tuberculosis, in that habitual drunkenness had obviously lowered the natives' physical resistance to tubercular infection especially that of their young men, who were the principal offenders Most likely the two young TB victims who died at Schönbrunn had come to the Mission in their extreme despondency seeking physical help as well as protection from further alcoholic temptations, for they knew that in the Moravian settlements 'spiritous liquors" were not tolerated Motivated by former experiences at their Mission town of Langundo-Utenunk, and by more recent ones at the newly founded Missions of Schönbrunn and Gnadenhutten, Zeisberger, Heckewelder, and Ettwein decided to enforce relentlessly the Mission statute prohibiting both the importation and the use of intoxicating liquor within the precincts of a Moravian settlement The mission diaries record no infraction of this rule In fact, the Moravian example caused the Grand Council in Gekelmukpechünk, early in 1773, to pass a similar law for the heathen capital, which, on March 6, was most drastically enforced, according to the following entry in the Schönbrunn Diary (16)

> "Two days ago, in Gekelemukpechünk, in pursuance of their resolutions, they had accomplished the first carrying into effect of their Acta, smashing ten barrels of rum for a trader and pouring out the contents on the ground, even before he came into their town"

Unfortunately, the good intentions of King Netawatwes' government were of a deplorably short duration In Schönbrunn, however, the prohibition statute was all the more rigorously enforced Under March 2, 1774, the Diary reads, as follows (17)

> "We spoke with Indians who had come from Pittsburg, bringing rum with which to trade with the Indians, telling them that if they had such wares they should take another route, not passing through here The same notice will be given traders who come here or pass through"

When, on April 6 1775, drunken Indians arrived at Schönbrunn, with horse-loads of rum, their liquor was poured out, the Diary carries this comment (18)

> "Thus we do with all Indians and white people, without respect of persons, who come into our Town or neighborhood with such wares They may not use them as they please, so long as they are here, when they leave, they are accompanied to our borders"

Thus Schönbrunn was effectively protected against the plague of alcoholism, safeguarding, thereby, in great measure, its inhabitants' resistance to phthisic infection Although, of course, the one or other case of pulmonary tuberculosis, in the community, may have remained undetected, yet the fact remains that the disease was definitely not endemic at Schonbrunn

Another epidemic, however, although of an entirely different character, is mentioned in the Schönbrunn Diary, under date of July 17, 1773, as having attacked the children of the community This entry, made in connection with the death of a four months old baby girl, reads as follows

> " A bad cough which has infested this entire region and, since the spring of the year, had taken a toll of 50 children in Gekelemukpechünk [the Lenni Lenape capital town, *ACM*] alone, has also spread among our own children, and only a very few have been spared"

The Gnadenhütten Diary, on August 10, 1773, concludes the report of a two-year old girl's death with the remark that "a blue cough accelerated her departure" [*"ein blauer Husten beförderte ihren Heimgang"*], indicating that Gnadenhütten, halfway between Gekelemukpechünk and Schönbrunn, likewise suffered from the cough epidemic It is possible that this epidemic cough, with its numerous casualties, was an especially vicious incidence of whooping-cough, especially vicious, perhaps, because it may have attacked these Indians for the first time in their history Yet it is also possible that it may have been a symptom of some other epidemic children's disease which, for lack of other symptoms recorded, cannot be identified It is quite certain that the contagion was carried, to both Gnadenhütten and Schönbrunn, by visitors from the nearby heathen town so frequently mentioned in the diaries From the Schönbrunn burial statistics, it seems more than likely that, apart from the one assured "cough" fatality, some more, if not all, of the nine infant deaths in 1773 had been caused by that epidemic

Apart from what he called "pulmonary consumptions," Heckewelder (19) lists, as the principal "disorders to which the Indians are most commonly subjected, fluxes, fevers and severe rheumatisms," with the comment, that they are "all proceeding probably from the kind of life they lead, the hardships they undergo, and the nature of the food they take" In the light of present day dietetics, their daily menu, mainly consisting of corn, beans, nuts, squashes, pumpkins, fresh and dried meat, fowl, fish, eggs of hens and turtles, various fruit, and even milk, buttermilk, and butter, maple sugar, and (very little) salt, constitutes an almost ideally varied and balanced diet such as cannot possibly be held responsible for the disorders listed above. In fact, on his very next page, Heckewelder makes the following statement (20):

> "The gout, gravel, and scrofula or king's evil, are not known among the Indians. Nor have I ever known any one that had the disorder called ***Rickets***."

Only one of these, scrofula, has nothing to do with nutrition, gravel, or kidney stones, may have a nutritional cause, but gout and rickets are definitely nutritional diseases. Their total absence, in any region, is sure proof of a highly adequate diet.

Heckewelder's term, "fluxes," means diarrhoeas of various origin. In the light of modern medicine, they are symptoms of diseases rather than diseases in themselves, mostly, of infectious diseases such as dysentery, and others.

The same is true for Heckewelder's "bilious fever" (21), which, in older medicine, was regarded as a disease in itself: *Febris biliosa*. Today, it is listed as one of the symptoms of a number of diseases such as typhus, gall-stones, and other disorders of the liver and the bile duct. Zeisberger (22), in the Schönbrunn Diary, describes the case of a man "who had died . . . some time after" recovering from some ailment, "he experienced a chill which ended in a yellow fever that continued for eleven days," then he died. The eleven-day fever period makes it appear somewhat doubtful whether this was malaria (which frequently is attended by jaundice), or not rather a case of some other infectious disease involving the gall duct and liver. We are equally in the dark about what Heckewelder calls the "*yellow vomit*, which at times, carries off many of them. They generally die of this disease on the second or third day after the first attack" (23). In speaking of "bilious fevers" in general, he states (24):

> "that these fevers generally make their first appearance in the season of the wild plum, a fruit that the Indians are particularly fond of. Sometimes also after a famine or long suffering for want of food, when they generally make too free an use of green maize, squashes and other watery vegetables."

Rather than cause these intestinal disturbances and the fevers attending them, the fruits and vegetables mentioned may have aggravated the patients' condition, especially when excessively used. It is well known today that most seasonal diseases are due to the prevalence, at the particular season, of their inciters. The principal cause of all these diarrhoeas and bilious disorders was doubtless the general sanitary situation in the Indian settlements. Zeisberger (25) has this to say:

> "The brass kettles in which they cook, the dishes which they make of the growths and knots of trees, and also their spoons, which are usually very large, are rarely washed. . . . Yet in this respect, also, one finds differences, for some are as cleanly as one could expect it. The Monsys and the Mingoes, however, far excell the Delawares in uncleanliness, and, since the dogs are in their houses or lying about the fires, there are universally many fleas and other insects."

As the Monsys, here mentioned, were a Lenni Lenape tribe living at the Big Beaver, the "Delawares," whom they excelled in uncleanliness, apparently were the Lenni Lenape in the Muskingum area. What Zeisberger says about the dogs in the houses is clearly meant to have universal validity. It is uncertain, however, whether the following statement of Zeisberger (26), likewise applies to the Ohio Lenni Lenape:

> "Sometimes they [the spoons] are only licked by the dogs in lieu of washing."

Although there is evidence (27) that the Missionaries and their wives tried to raise their converts' standards of cleanliness, it is uncertain to what extent such attempts were successful

After calling the Indian bed, made up of "a mat with one or more deer or bear skins upon it, a comfortable couch in summer time," Zeisberger (28) states that it "may be made very uncomfortable by the fleas brought in by dogs" At another place (29) he remarks that "bedbugs are to be found in the Indian huts at any time and fleas in the summer, not a few"

Such filthy conditions, favoring the spread of any kind of infection, were made considerably worse when a sick person was in the house, especially one with an infectious intestinal disease Zeisberger (30) writes, as follows

> "Care and attention for the sick amount to but little the Indians being poor nurses So long as they can go out [to relieve themselves, *ACM*] they lie on the hard bed of boards no longer able to do this they are laid on the ground near the fire [which is in the center of the house, *ACM*], possibly upon grass or hay, a small hole in the ground under the patient serving as a bed-pan"

No further comment is needed

The worst scourge in the life of the inhabitants of Schonbrunn, Indian as well as white next to malaria, was what both Zeisberger and Heckewelder call by the collective name of rheumatism Heckewelder (31) states that "their old men are very subject to rheumatisms in the back and knees," while Zeisberger (32) remarks that "with advancing years" they commonly contract rheumatism, "often leading to lameness, deafness or blindness" It is evident that the term denotes symptoms of various diseases, symptoms of an arthritic nature, coupled with other symptoms All these rheumatisms were invariably treated mainly by "bathing and sweating" (33) Heckewelder attests a successful sweat cure administered in the Lenni Lenape fashion to himself, when suffering from rheumatism (34), in September, 1772, at Schönbrunn (35) More about this later

In connection with the matter of rheumatism, Heckewelder (36) makes the following remark which is of some significance for medical history particularly of the Tuscarawas area where most of his observations were quite evidently made He writes

> " I have seen boys 10 and 12 years of age, who through colds or fits of sickness had become so contracted that they never afterwards recovered the use of their limbs"

What Heckewelder here describes is plainly Poliomyelitis of especial significance is his aetiological, though erroneous comment "through colds or fits of sickness," for it has been observed that, frequently, a very early symptom of infantile paralysis is a 'running nose,' the "fits of sickness" evidently were such convulsions as are known to occur in the pre-paralytic stages of Poliomyelitis It is likewise of importance that no epidemic incidence of the disease is described in the diaries of Schönbrunn or of any other Moravian Indian Mission in Ohio

In an area in which both rattlesnakes and copperheads were frequent, occasionally people were bitten, yet deaths from snake bites were rare Zeisberger (37) writes, as follows

> "Indians who have been bitten, even if they happen to be quite alone in the forest, know what to do They seek certain herbs and roots that may be found anywhere and cure themselves of the bite, so that one rarely hears of a death occasioned by the bite of this serpent [rattlesnake]"

Apparently, the medical aid available in the Schönbrunn Mission community was adequate It is certain that there was no white physician at, or even near, Schönbrunn, nor was there need for any Both Heckewelder and Zeisberger attest that the Indians not only had competent professional practitioners of both sexes with a sound knowledge of their native *materia medica*, but that there were also a great many non-professional men and women in possession of medical recipes, the composition of which they jealously guarded as valuable secrets Besides, there were also, in every heathen community, "medicine men," who combined natural treatment of ailments with magic hokus-pokus Of course, they were not to be consulted by the Mission populace On the other hand, it is most likely that, in cases of emergency, the one or the other serious practitioner was called in from the heathen neighborhood In most cases, though, the medical knowledge available among the Mission Indians seems to have sufficed After criticizing the common Indian habit of dosing their patients excessively, Heckewelder makes this statement about native physicians (38)

> "Nevertheless, I must say, that their practice in general succeeds pretty well I have myself been benefited and cured by taking their emetics and their medicines in fevers, and by being sweated after their manner while labouring under a stubborn rheumatism I have also known many, both whites and Indians, who have with the same success resorted to Indian physicians while labouring under diseases The wives of the Missionaries, in every instance in which they had to apply to the female physicians, for the cure of complaints peculiar to their sex, experienced good results from their abilities They are also well skilled in curing wounds and bruises I once for two days and two nights, suffered the most excruciating pain from a felon or whitlow on one of my fingers, which deprived me entirely of sleep I had recourse to an Indian woman, who in less than half an hour relieved me entirely by the simple application of a poultice made of the root of the common blue violet I firmly believe that there is no wound, unless it be absolutely mortal, or beyond the skill of our own good practitioners, which an Indian surgeon (I mean the best of them) will not succeed in healing "

The greatest asset of aboriginal, and particularly Lenni Lenape, therapy no doubt was the sweating-oven Since Heckewelder was successfully "sweated after their manner" for rheumatism, in September, 1772 (39), the Mission Indians of Schönbrunn must have installed their local sweating-oven shortly upon the founding of their settlement, in fact, two of them, since the women had their own These sweating-ovens were considered an indispensable necessity in every Indian settlement, from the Pacific to the Atlantic Heckewelder (40) describes the Lenni Lenape sweating-oven, such as used by himself at Schönbrunn, as follows

> "The sweat oven is the first thing that an Indian has recourse to when he feels the least indisposed, it is the place to which the wearied traveler, hunter, or warrior looks for relief from the fatigues he has endured, the cold he has caught, or the restoration of his lost appetite This oven is made of different sizes, so as to accommodate from two to six persons at a time, or according to the number of men in the village, so that they may be all successively served It is generally built on a bank or slope, one half of it within and the other above ground It is well covered on the top with split plank and earth, and has a door in front, where the ground is level, to go or rather creep in Here, on the outside, stones, generally of about the size of a large turnip, are heated by one or more men appointed each day for that purpose While the oven is heating, decoctions from roots of plants are prepared either by the person himself who intends to sweat, or by one of the men of the village, who boils a large kettleful for the general use, so that when the public cryer going his rounds, calls out *Pimook!* "go to sweat!" every one brings his small kettle, which is filled for him with the potion, which at the same time serves him as a medicine, promotes a profuse perspiration, and quenches his thirst As soon as a

> sufficient number have come to the oven, a number of the hot stones are rolled into the middle of it, and the sweaters go in, seating themselves or rather squatting round those stones, and there they remain until the sweat ceases to flow, then they come out, throwing a blanket or two about them that they may not catch cold, in the meanwhile, fresh heated stones are thrown in for those who follow them While they are in the oven, water is now and then poured on the hot stones to produce a steam which they say increases the heat, and gives suppleness to their limbs and joints "

Then he continues with this phrase which clearly reflects a personal recollection of his sickness and its cure, in 1772

> "In rheumatic complaints, the steam is produced by a decoction of boiled roots, and the patient during the operation is well wrapped in blankets, to keep the cold air from him, and promote perspiration at the same time "

Heckewelder concludes his description with the following remarks

> "Those sweat ovens are generally at some distance from an Indian village, where wood and water are always at hand The best order is preserved at those places The women have their separate oven in a different direction from that of the men, and subjected to the same rules The men generally sweat themselves once and sometimes twice a week, the women have no fixed day for this exercise, nor do they use it as often as the men "

The south slope of the Schönbrunn pleateau, with the lagoon near by, "where wood and water are always at hand," answers to perfection Heckewelder's description of the locality of the sweating-oven for both men and women

The Rev David McClure who, in 1772, visited the Lenni Lenape capital of Gekelemukpechünk, where he saw a sweating-oven in operation adds the significant information (41) that "to pulmonary disorders it is fatal, as also in the small pox "

Not a single case of this latter disease is recorded in the Schönbrunn Diaries or, so far as I know, in any of the diaries from the other Moravian missions in Ohio That is quite astounding, in view of the past ravages of the disease in the East, on which McClure makes this comment "This latter scourge of the human race has swept off multitudes of Indians from this continent "

With the Schönbrunn Lenni Lenape it may have been a matter of acquired immunity A great many of them had come to Schönbrunn with the Moravians from Missions in Pennsylvania, some even from as far east as Bethlehem, and it is almost certain that they all had, once in the past, overcome the smallpox Most likely, for the same reason, the white traders from the East, who regularly visited both the Missions and the heathen settlements in Ohio, were likewise immune, otherwise, fresh infections with smallpox would inevitably have occurred, at least among the children and younger people

Zeisberger, Heckewelder, and McClure, in various instances, mention the sexual promiscuity and the alarming spread of Venereal Diseases among the Lenni Lenape The Schönbrunn mission statutes successfully kept these moral and physical disorders out of the settlement by outlawing all offenders of either sex, and by insisting on the sacredness of the marriage bonds, which, in the heathen neighborhood, had long been scandalously ignored The Schönbrunn Diaries fail to indicate to what extent previously infected converts, otherwise in good standing, contaminated their spouses and offspring Yet it is reasonable to assume that numerous ailments of both adults and children, especially infants, could have been traced, in the light of modern diagnosis, to venereal infections

The List of Burials in the Schönbrunn Cemetery, from 1772 to 1777 (42), provides the mortality figures for this period In 1772, out of a total of 92 inhabitants, only one person, an infant girl, was buried Fifteen people, including nine infants, out of a total of 184 souls, died in 1773 That is the only year for which the Mission Diary shows a direct correlation between the death rate and local health 1773, as previously stated was a bad malaria year and also the year of the cough epidemic mentioned above (p 125) In 1774, four persons, including two infants, were buried, of a population of 220 The mortality figure of 1775 is seven persons, among them three infants, the total population was 263 Out of an estimated total of over 300 people, in 1776, twelve were buried, including "five children," whose age is not given In 1777, only one funeral is listed, in January, from then on, until April 19, when the Mission was abandoned, nobody seems to have died

It is to be noted that the population of Schönbrunn increased, as substantially and steadily as it did, by immigration rather than by births Moreover, the babies born were not so consistently recorded in the Mission Diaries as were those who had died Yet it is evident that the mortality of infants was high over one-half of all deaths, each year, were infants

Referring not to infants in particular, but to children in general, Heckewelder (43) states that "worms are a very common disorder among" them, and that

> "great numbers of them died from that cause They eat a great deal of green corn when in the milk, with beans, squashes, melons, and the like, their bellies become remarkably large, and it is probably in that manner that the worms are generated "

Here again we have Heckewelder's frequent reversal of cause and effect, medical science knows that a distended and protruding abdomen, in a child, frequently indicates Hookworm infection (Ancylostomiasis), or the presence of Ascarides (Ascariasis), in which cases the vegetables and fruits, mentioned above, most likely made bad matters worse Although Heckewelder's observations were made with no particular reference to Schönbrunn, yet they may be safely applied not only to Schönbrunn but also to the other Moravian mission settlements, as well as to the pagan communities of the area The same is true for Trichinosis Heckewelder (44) tells a story which makes it evident that the pigs were left at liberty to roam in the forest When an infected pig was eaten by a bear, or died and was eaten by another pig, the people who ate of that bear s or other pig's flesh were most likely to contract Trichinosis The general Indian habit, however, of cooking their meats and fish "so thoroughly that they fall apart," as stated by Zeisberger (45), may have substantially curbed the incidence of Trichinosis, although it probably did not prevent it entirely

All available evidence points to it that the health conditions, in the Moravian Mission town of Schönbrunn, during the five years of its existence, were as good as could be expected in the close proximity to a malaria swamp, and in the almost total absence of such sanitary measures as are today considered the minimum requirement for healthy living, even in a primitive environment Had not Schönbrunn enjoyed the ample and excellent drinking water from the Beautiful Spring that lent it its name, the health conditions of the place probably would have been even much worse True, the preventive measures taken, in many respects, by the Mission authorities, helped to establish certain rudiments of hygiene and principles of moral conduct, that no doubt made their converts better men and women than were their pagan neighbors Yet it is equally apparent that, without the recourse which the Missionaries and their families were incessantly forced to take to the aboriginal resources of the wilderness, and to the age-old experience and medical lore of their native charges, they would have been hopelessly lost

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NOTES

(1) *SD 1*, June 28, 72
(2) *HH*, p 220
(3) *ZH*, p 75
(4) *SD 2*, Sep 28, 72
(5) *GnD*, Aug 18 '73
(6) *GnD*, Sep 21, '73
(7) *SD 12*, Sep 30 75
(8) *SD 12* Oct 22, '75
(8a) *MMNO*, p 13 f
(9) *HH*, p 224 f
(10) *ZH*, p 27
(11) *SD 12*, Jan 2, 76
(12) *SD 5*, July 2, '73
(13) *SD 12* Dec 7 75
(14) *HH*, p 223
(15) *McCD* pp 71-78
(16) *SD 3*, Mar 8, '73
(17) *SD 7* Mar 2, 74
(18) *SD 10*, Apr, 6 75
(19) *HH*, p 222
(20) *HH*, p 223
(21) *HH* p 222
(22) *SD 5*, Sep 5, '73
(23) *HH* p 222
24) *ibid*
(25) *ZH*, p 16
(26) *ZH*, p 86
(27) *GnD*, June 29 '73 *SD 10*, Apr 27 75, *SD 12*, Jan 15 '76
(28) *ZH*, p 86
(29) *ZH*, p 75
(30) *ZH*, p 24
(31) *HH*, p 222
(32) *ZH*, p 24
(33) *ZH* p 55
(34) *HH*, p 229
(35) *SD 2*, Sep 28 '72
(36) *HH*, p 222
(37) *ZH*, p 222
(38) *HH*, p 229
(39) *SD 2* Sept 11 72
(40) *HH* p 225
(41) *McCD*, p 67
(42) ms MAB
(43) *HH* p 222
(44) *HH*, p 147
(45) *ZH*, p 14

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NUMBERS AND SUCCESS

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It is easy to remove passages from a general discussion and attribute to them a meaning they were not intended to have Also, in a long discussion, statements *may be made so far from expressions of the central concept that their significance* is overlooked

Presumably in one of these ways Dr McAtee (1949) in this journal has misapplied some remarks of mine (Shull, 1936) concerning the road to success in evolution After quoting part of an account of the way in which natural selection was at first supposed to work through life-and-death distinctions, he portrays my substitute for that method as dependent on the thesis that "success or failure depends on numbers," and that "numbers   constitute the best assurance of permanence " He then proceeds to apply this concept to species His reader no doubt compares the number of grizzly bears with the number of flies that annoy them, and concludes that if the numbers of individuals were equal the bears could be fairly happy—irrespective of their chances of survival as compared with the insects Man with his two billion or so should be in no danger—unless, as some people fear, from himself, but a bacterial species made up of only two billion individuals might well be on the verge of extinction No one could seriously maintain that numbers of individuals, without reference to the kind of organism, would be a good measure of success or a good insurance policy

To understand the wrong application here, one must remember that the book quoted was the first *general* work on evolution to emphasize the genetic factors The early chapters dealt with the traditional arguments about evidences of evolution, but long before page 152, from which McAtee quotes, the genetic groundwork was laid and the evolutionary operation of the genetic mechanism was described A species was best described as possessing various alternative genes in certain frequencies—68 per cent of *A*, 19 per cent of *a*, and 13 per cent of *a'*, and so on for all the loci of genes in the chromosomes The frequency of one of these genes would change from generation to generation, and such changes would be evolution Even if they never led to a change of phenotype which a taxonomist would dignify by calling a new species, the change of frequency of alternative genes was really evolution Much evolution has been lost, but it was evolution The bulk of evolution has been effected by such changes of frequency of genes

When gene *A* first mutates to *a*, the latter gene is rare Accordingly, it may be lost But to be lost, the individual that contains it must be lost or its germ cells fail to contribute to new individuals If gene *a* is to increase in frequency, the individuals that contain it must leave relatively more descendants than do those containing only *A* Whether more descendants are to be had by good luck, or only by possessing some advantage associated with gene *a*, is immaterial, increase of the frequency of the new gene requires increase of the individuals carrying it Such increase of individuals could be arrived at by further mutations of *A* to *a* If *A* mutates to *a* often enough, and there is no opposing factor, gene *a* gradually replaces *A* The whole species could eventually be made to possess gene *a*, to the exclusion of *A*, merely by repeated mutations to *a* All this would involve, of course, getting more and more individuals carrying the new gene

The import of "numbers of individuals" should now be clear Numbers of elephants are not being contrasted with numbers of mice No species is contrasted with another species It is numbers of individuals carrying gene a instead of A, or carrying gene m instead of M or m', that matters If gene b is to succeed in evolution, at the expanse of b' or B, that success can be attained only by increasing the number of individuals possessing b An effective way of getting an increase of such individuals, after the new gene comes to expression, is for it to possess an advantage over the old gene This advantage must be one that leads its possessor to produce more descendants A new gene that makes the life of its possessor more comfortable, but does not increase its descendants, is not advantageous in the evolutionary sense Such a gene, if it succeeded in becoming permanent, would owe that success to some other factor than selection, but whatever that factor were, it would have to operate by increasing the number of individuals possessing the new gene

The paragraphs containing the passages quoted by McAtee contain nothing to indicate that it is success of species in relation to other species that is insured by numbers of individuals Not even the page, nor the chapter, nor the whole book gives any expression to that idea Everywhere it is characters, more directly the genes, whose permanence is made more probable by numbers of individuals Though the words 'class" and "type ' are used in no part of the discussion do they have a taxonomic meaning The "class" of individuals possessing a certain gene is contrasted with another ' class" or ' type" having one of the alternative genes at the same locus The reader should have no difficulty in seeing that the words have that meaning If one of these "classes" has more descendants, its genetic basis becomes more prevalent—is more successful It would be unfortunate to have the genetic argument used in support of mere numbers as a measure of success of species particularly of unrelated or only distantly related species

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A DESCRIPTION OF WARNER S HOLLOW

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It is the purpose of this report to describe an area in Ohio of great natural beauty with which it is believed that very few people are familiar The Hollow is quite inconspicuous when passed from a distance on the main route and this circumstance alone has largely contributed to its isolation In spite of the fact that a 4H camp has been erected upon the southwest rim of the region very little attention has been attracted to the Hollow scientific attention in particular

The author feels that biological potentialities of Warner s Hollow are enormous This area would very probably make an interesting ecological study

Warner s Hollow is situated in the extreme southwestern portion of Ashtabula County and near the town of Windsor As shown in Fig 1 the Hollow can be reached on routes 534 (south from Geneva on the Lake) and 322 (east from Cleveland) as both roads pass through Windsor

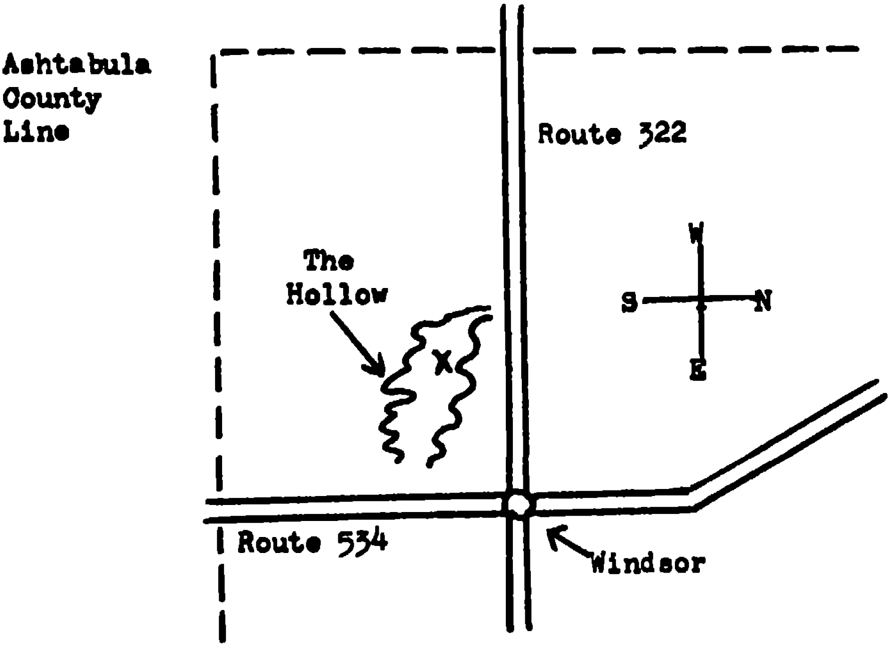

Fig 1

The region extends lengthwise in an east and west plane The floor of the Hollow is quite convoluted the distance along the bottom from end to end being approximately two miles At its widest place the Hollow is roughly 1200 feet and its narrowest about 20 feet the distance being estimated from the top of the north wall to the top of the south wall

The Hollow is a glacier and river worn gorge which opens sharply in the midst of gently rolling landscape that characterizes this portion of northeastern Ohio

A stream flows from west to east along the floor of the gorge The stream is called Phelps Creek and is a tributary of the Grand River The Creek is spring fed while in the Hollow and is quite shallow except for occasional pot holes of depth from six inches to six feet One spring of very fine cold water is located on the north wall and may be readily reached by means of a foot path which winds along the cliff

According to Mr Tom White, who owns a considerable portion, it is believed that a part of the area was once an Indian fort Arrowheads and similar relics have been found in and around the gorge

The rock content of the Hollow is predominantly sandstone, shale, and some limestone Fossil shells of mollusks have been found in the sandstone of the south wall, Pelecypod shells mostly represented

A considerable portion of the gorge walls are bare rock and either sheer or jutting and sometimes both The highest point of the Hollow above the stream is located on the south wall and is roughly 110 feet in height

Imprints of fossil leaves and tree bark have been observed on the rocks in the bottom of the gorge near the creek

An isolated formation called table rock is found rising from the floor of the Hollow and is roughly 45 feet in height This structure was apparently dislodged by a previous rockfall possibly caused by extensive undermining of the north wall by river erosion The rock top is quite flat and covers about 600 square feet It is tilted somewhat toward the north Although in recent years the top of table rock has been somewhat defaced by campers, there are still visible near the south edge and overlooking the stream, a pair of footprints of a girl's bare feet Popular legend as related by several natives claims that, "once an Indian maiden, pursued by two male Indians with dire intent, stood finally upon this spot while the earth here was yet soft and debated whether or not to jump " Also according to popular legend she jumped and so it goes on to state, "the footprints have remained to this day " Actually, one of the local dwellers was an amateur sculptor, who, using his daughter as a model, chiseled the footprints in the rock surface Opening near the base of table rock are several small openings about six inches in diameter which lead inside to a chamber known as Barometer Cave, so called because of the response of its air currents in relation to weather fluctuations

Winding along the walls on both sides are narrow footpaths, some located beneath far-jutting rocks These paths are largely the result of natural conditions

Warner's Hollow is an abrupt change from the surrounding landscape, not only from a geological standpoint but also that it is characteristic of a Canadian Life Zone

Considerable stands of Native Hemlock are present as well as Mountain Maple Ground Yew is well represented Lichens are very numerous The Bryophytes are plentiful Liverworts and various types of mosses thriving in shady nooks and on the dripping wet rock walls, other types of mosses on the woody summits of the walls are also plentiful

The Pteridophytes are well represented, there being several different kinds of ferns and Equisetineae The Club mosses are especially abundant, being found in the rich shade of bottom land and upper woodland in the immediate vicinity of ground Yew

The animal life is quite similar to the surrounding countryside with the possible exception of the Newts and Salamanders The Caudata are represented here by ***Triturus viridescens*** (most numerous), ***Plethodon jordani***, and ***Eurycea lucifuga*** These forms of the Caudata are so plentiful that they may be observed crawling about in the wooded areas and among the rocky ledges of the Hollow all day long

The Author wishes to express most sincere appreciation for the aid given in this endeavor by the Junior 4H Group of Ashtabula County and also hopes that some curiosity has been incited by this paper so that Warner s Hollow may receive more of the attention which it deserves

STUDIES ON FRESH WATER BRYOZOA,
XVII MICHIGAN BRYOZOA

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INTRODUCTION

The purpose of the present study is to record the occurrence of several bryozoan species from localities new to Michigan and other regions to compile a list of the bryozoa previously recorded from Michigan and to correct or revise the identification of some of the species collected long ago

Records published by various writers from 1882 through 1949 have reported the following bryozoa from different Michigan localities sometimes under synonyms or outmoded names

Class ECTOPROCTA
  Order GYMNOLAEMATA
    Family Paludicellidae
      1 *Paludicella articulata* (Ehrenberg) 1831
  ORDER PHYLACTOLAEMATA
    Family Cristatellidae
      2 *Cristatella mucedo* Cuvier 1798
    Family Fredericellidae
      3 *Fredericella sultana* (Blumenbach) 1779
    Family Lophopodidae
      4 *Pectinatella magnifica* Leidy 1851
    Family Plumatellidae
      5 *Hyalinella punctata* (Hancock) 1850
      6 *Plumatella casmiana* Oka 1907
      7 *Plumatella orbisperma* Kellicott 1882
      8 *Plumatella repens* (Linnaeus) 1758
      9 *Plumatella repens* var *coralloides* (Allman) 1850
      10 *Plumatella repens* var *emarginata* (Allman) 1844
      11 *Stolella indica* Annandale 1909

The recorded localities for the above list of bryozoa are named in Table I The sixteen references from which the Table was compiled are on file with both authors and are not here reproduced

To the above listed species the present study adds the following two new Michigan records

Class ECTOPROCTA
  Family Plumatellidae
    Plumatella repens var *jugalis* (Allman) 1850
Class ENTOPROCTA
  Family Urnatellidae
    Urnatella gracilis Leidy 1851

In addition to the *Urnatella gracilis* and the *Plumatella repens jugalis* three other bryozoa (*Paludicella articulata* *Plumatella casmiana* and *Plumatella repens* var *emarginata*) were found in new localities in the present study collections Their distribution is given in Table II

TABLE I

PREVIOUSLY RECORDED MICHIGAN COLLECTION SITES WITH ASSOCIATED COLLECTORS AND BRYOZOA

	Near Ann Arbor	Bass Lake Livingston Co	Corunna	Douglas Lake	Ford Lake Otsego Co	Huron River Washtenaw Co	Lake St Clair	Little Traverse Bay	Shiawassee River central Mich	St Joseph s River Berrien Co	Traverse Bay	Whitewood Lake Livingston Co	Whitmore Lake
A Collectors reporting Bryozoa 1 C J D Brown 1933 1934	x	x		x		x						x	
2 J S Dolley 1933										x			
3 B R Green 1914 1916				x									
4 D S Kellicott 1882			x					x	x				
5 R Kenk 1949	x												
6 J W Leonard 1939					x								
7 D E Miller 1936				x									
8 J W Moffett 1943				x									
9 M R Raymond 1937		x											
10 J E Reighard 1894							x						
11 F Smith 1916				x									
12 H B Ward 1896											x		
13 O W Young 1945				x									
B Bryozoa reported by some of the above collectors 1 *Cristatella mucedo*				x	x						x		
2 *Fredericella sultana*		x	x	x							x	x	
3 *Hyalinella punctata*				x									
4 *Paludicella articulata*									x		x		
5 *Pectinatella magnifica*	x					x				x			
6 *Plumatella* sp				x									
7 *Plumatella casmiana*	x												
8 *Plumatella orbisperma*								x					
9 *Plumatella repens*	x			x									
10 *Plumatella repens coralloides*													x
11 *Plumatella repens emarginata*						x		x	x				
12 *Stolella indica*	x												

TABLE II

PRESENT STUDY COLLECTION SITES AND ASSOCIATED BRYOZOA

State	Michigan Sites					Indiana		Pennsylvania	Utah
Station	558	565	566	567	568	611	613	612	614
Urnatella gracilis		x	x	x	x		x		
Paludicella articulata	x	x	x	x	x	x	x		
Plumatella casmiana	x						x		
Plumatella repens var *jugalis*	x								
Plumatella repens var *emarginata*	x		x	x	x		x	x	x

TABLE III

MEASUREMENTS OF PRESENT STUDY STATOBLASTS

	*Plumatella casmiana**	*Plumatella repens* var *emarginata*
Floatoblasts *a* Total length	0 346– 360 mm	0 432 mm
b Total width	216– 245	230
c Capsule length	245– 266	281
d Capsule width	187– 202	206
e Dorsal side 1 Float length	086	144
2 Float width	043– 050	07
f Ventral side 1 Float length	058	115
2 Float width	029– 036	022
Sessoblasts *a* Total length	461– 475	461– 468
b Total width	360– 367	346– 389
c Capsule length	410– 418	403
d Capsule width	302– 317	288– 346
e Float width	029	029– 036

*The *Plumatella casmiana* floatoblasts here measured are of the ordinary type which is shown in Figures 8 and 9 and not of the other type which is shown in Figures 10 and 11

COLLECTION DATA

The material for the present study was collected within recent years from Michigan, Indiana, Pennsylvania and Utah It consists of nine batches or samples of material numbered 558, 565, 566, 567, 568, 611, 612, 613 and 614 Strictly speaking, this study should have included only the Michigan samples #558, 565, 566, 567 and 568, but rather than prepare a separate paper for the other four samples from Indiana, Pennsylvania and Utah, it was decided to include them in the same paper with the Michigan specimens

Sample #558 was collected by H van der Schalie on July 18, 1945, in Lake Erie at Pte Moullie, near the mouth of the Huron River, Monroe County, Michigan It contained *Paludicella articulata*, *Plumatella casmiana* and scraps of *Plumatella repens jugalis*

Sample #565 was collected by H van der Schalie on September 6, 1945, near the railroad bridge one mile above Ionia, in Grand River, Ionia County, Michigan It consisted of several empty mussel shells heavily encrusted with a thick mat of *Paludicella articulata* Some showed germinated hibernacula, as well as stalks of *Urnatella gracilis*

Sample #566 was collected by H van der Schalie on September 4, 1945, from the Grand River, near Ionia, Ionia County, Michigan It consisted of bivalves to which were adhering sessoblasts of *Plumatella repens emarginata*, old *Paludicella articulata* hibernacula and a few *Urnatella* stalks

Sample #567 was collected by H van der Schalie on September 5, 1945, from the Grand River below Lyons, Ionia County, Michigan It consisted of bivalves on which were growing dense clumps of *Plumatella repens emarginata*, a few sprigs of *Urnatella* and *Paludicella articulata* colonies and hibernacula

Sample #568 was collected by H van der Schalie on September 6, 1945, from Grand River below the Dexter Street Bridge at Ionia Michigan It consisted on bivalves overgrown with *Paludicella* colonies and hibernacula, *Urnatella* stalks and some *Plumatella repens emarginata* statoblasts

Sample #611 was collected by H van der Schalie on August 31, 1948, at Station 11 in Pigeon Creek just east of Flint, Jackson Township, Steuben County, Indiana It consisted of mussel shells, tiny rock fragments, pieces of broken glass and other debris, moderately covered with *Paludicella articulata* colonies and hibernacula

Sample #612 was collected by H van der Schalie and Harold W Harry on August 27, 1948, at Station 4 in Traverse Creek, a western branch of Racoon Creek, west of Clinton, Pennsylvania near U S Highway #30 It consisted of rock and mussel scrapings and some *Plumatella repens emarginata* statoblasts

Sample #613 was collected by Carl D Riggs on August 7, 1946, from Tippecanoe River, seven miles below Pulaski, Pulaski County, Indiana It consisted of mussel shells encrusted with *Urnatella gracilis*, *Paludicella articulata* and *Plumatella casmiana*

Sample #614 was collected by H van der Schalie and Elmer G Berry on June 16, 1934, from Nibley Park Stream at Salt Lake City, Utah, and contained *Plumatella repens emarginata* scrapings

The five bryozoan species from the above samples are listed in Table II and are discussed in more detail in the following section

DISCUSSION

Urnatella gracilis

Urnatella gracilis is a colonial form consisting of one to six beaded or segmented stalks arising from a basal plate The stalks are tipped by a calyx or head and may have additional short branches and calyces arising from the main beaded stalk Sometimes there is a cluster of such small branches near the distal tip of the stalk Other times there are sparse branches arising from several regions along the stalk Bracket or handle-like structures on the stalk indicate the bases of broken off branches (see Fig 16)

The number of segments in the stalk varies from one to eighteen Those nearest the basal plate are conspicuously urn-shaped (see Fig 14), those more distal are more bead-like, softer in texture and lighter or paler in color The basal segments are usually deeply colored (amber, brown or black), depending upon age The deepest coloration is in the constricted region of each segment A dark perforated septum incompletely separates successive segments Davenport (1893, p 7) found the top septum which separates the calyx from the stalk to be somewhat more complex than the other septa He also reported seeing flame cells and yolk granules in the stalk

Each stalk terminates in a calyx These calyces or heads may drop off and new ones may regenerate from the stalk tip, apparently as in *Barentsia laxa* and related species The calyx is rimmed by 8 to 16 tentacles which are not retractile but roll inward, as in other Entoprocts (see Rogick, 1948, *Barentsia laxa* figures, especially Figs 15, 17, 19, 20, 22, 24 and 33) The internal anatomy of the calyx, as described in Davenport's 1893 paper, appears to be similar to that of *Barentsia laxa* Davenport (p 15) was able to find only adult male zoids so could not study the sexual reproduction of *Urnatella* or the anatomy of female specimens, so that is one of the problems remaining for some future worker

Richardson (1921, p 442) reported *Urnatella* as feeding on diatoms

The present specimens were collected in Grand River, Ionia County, Michigan, and in Tippecanoe River near Pulaski, Indiana, see Table *II*

The known distribution records for this as yet exclusively American bryozoan are as follows Leidy found *Urnatella gracilis* on a number of occasions between 1851 (p 322) and 1884 (pp 5–6) around Philadelphia in the Schuylkill River, below Fairmount dam, on the underside of stones, shells, on eel grass *Vallisneria spiralis* and on water star grass *Schollera graminea* His friend, Dr Isaac Lea, showed him a *Unio* shell from the Scioto River in Ohio on which were some *Urnatella* remains Davenport (1893, p 2) and Potts in 1892 collected *Urnatella* in great quantities from the turbulent waters immediately below the overflow of

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EXPLANATION OF PLATE I

All figures were drawn from preserved material with the aid of a camera lucida

Fig 1 An old *Plumatella repens* var *emarginata* sessoblast The free surface of its large dark capsule is roughened by slightly raised ridges Drawn to Scale A

Fig 2 *A younger Plumatella repens* var *emarginata* sessoblast Dissected out of the same colony as floatoblasts on Figures 3 and 4 Drawn to Scale A

Fig 3 The dorsal surface of a *Plumatella repens* var *emarginata* floatoblast, showing the dark capsule about half covered by the float Drawn to Scale A

Fig 4 The ventral surface of a *Plumatella repens* var *emarginata* floatoblast showing the lesser encroachment of the float upon the capsule Drawn to Scale A

Fig 5 Edge view of *Plumatella repens* var *emarginata* floatoblast showing the flat dorsal face and curved ventral face The statoblast is resting on its dorsal face in this figure Drawn to Scale A

Fig 6 A sessoblast of *Plumatella casmiana* It closely resembles those of *P repens* var *emarginata* Drawn to Scale A

Fig 7 Edge view of one type of *Plumatella casmiana* floatoblast Adapted from Study XIII, p 267, Fig 7 (Rogick 1943)

Fig 8 Ventral face of a *Plumatella casmiana* floatoblast of the same type as the preceding Drawn to Scale A

Fig 9 The dorsal face of a *Plumatella casmiana* floatoblast of the same type as the preceding Drawn to Scale A

Fig 10 Face view of the second, distinctive thin walled type of floatoblast of *Plumatella casmiana* Drawn to Scale B

Fig 11 Edge view of the same type of *Plumatella casmiana* floatoblast as the preceding Drawn to Scale B Adapted from Study X, p 218, Fig 3 (Rogick, 1941)

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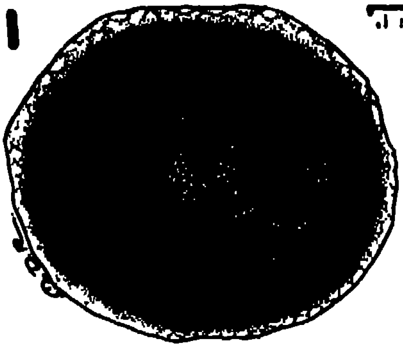

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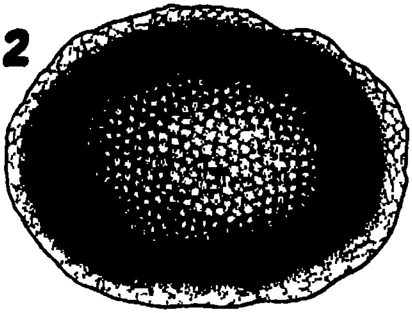

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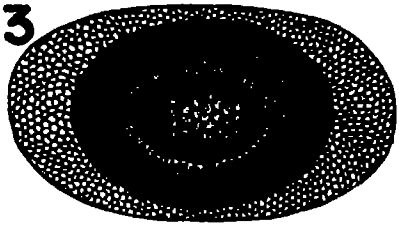

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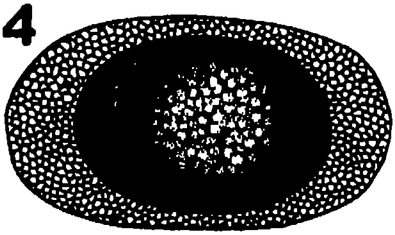

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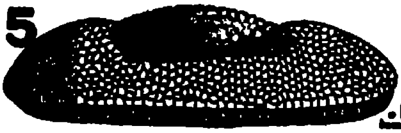

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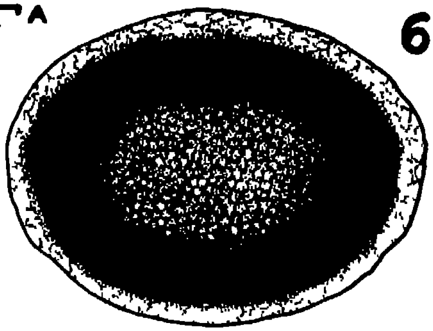

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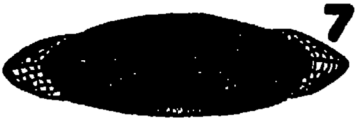

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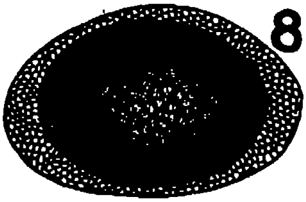

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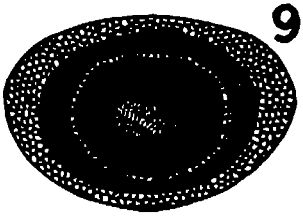

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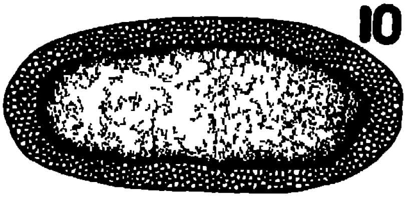

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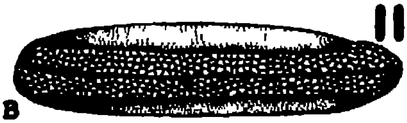

the Flat Rock Dam in the Schuylkill Canal near Shawmont Station, Pennsylvania It covered almost every stone Kofoid (1898, p 402) found *Urnatella* at Havana, in the Illinois River near the Illinois Biological Station and in 1908 (p 290) in the channel bottom of the river on Unionidae shells Hempel (1899, p 341) also found it in the Illinois River, from bottom towings Richardson, between 1921 and 1928, reported the species from several localities along the Illinois River, namely at Havana (1921, p 440), in Peoria Lake below Chillicothe (1924, p 380), at McKinley Bridge and Pekin, Illinois, in a strong current (1925, p 417); and from LaSalle to Beardstown (1928, pp 391, 407) Williams (1930, p 280) reported *Urnatella* from Licking River in Kentucky Rogick (1935, p 258) found *Urnatella* in a number of Lake Erie, Ohio, localities Several years ago specimens from Clinton River, Michigan, were sent to the senior author by Dr C J. D Brown *Urnatella* has been observed in Lake Dallas, Texas, by Dr B B Harris and in the Mississippi River near Fairport, Iowa, by Dr R C Osburn

Paludicella articulata

Paludicella articulata is a dainty yellow to brownish form growing in fine traceries on all types of submerged materials (shells, rocks, etc.) It is closely adherent but when its branching is luxuriant and the substratum limited in area it forms a soft, loosely felted mat Instead of forming statoblasts as do most fresh-water bryozoa, *Paludicella* produces germinative bodies or "winter buds" called hibernacula (see Figs 13, 15, 17, 18) These hibernacula are generally darker and much more opaque than the ordinary zoids They are usually irregular in shape and split apart on germination but not so regularly as do statoblasts The zoids are long, slender, spindle-shaped and linearly arranged One or two zoids may sprout at an angle from the sides of each zoid (see Fig 19) The zoids have a projecting, squared orifice The tentacles number 16 to 18

Paludicella articulata has a very wide distribution In the present material it was found in abundance in the Michigan and Indiana samples (see Table II) It has previously been reported from a number of U S A localities by Davenport Richardson, Rogick and Ward It has been reported by various writers from Belgium, Canada, China, England, Esthonia, Finland, France, Germany, Greenland, Hungary, India, Ireland, Italy, New Zealand, Norway, Russia, Scotland, Siberia and Switzerland

Plumatella casmiana

There was some question as to whether this form should be called *Plumatella casmiana* or *Plumatella repens* var *casmiana* Dr Toriumi, in his excellent 1942b

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EXPLANATION OF PLATE II

Fig 12 Sprig of a dead *Plumatella casmiana* zoarium showing somewhat angular, distinctly keeled zoids Drawn to Scale C

Fig 13 Fragment of a pale-colored empty *Paludicella articulata* zoid from which the dark irregular hibernaculum had originated Drawn to Scale B

Fig 14 Two *Urnatella gracilis* stalks attached to the same basal plate Because this was preserved material some of the more distal segments are slightly collapsed and the calyces are missing Drawn to Scale B

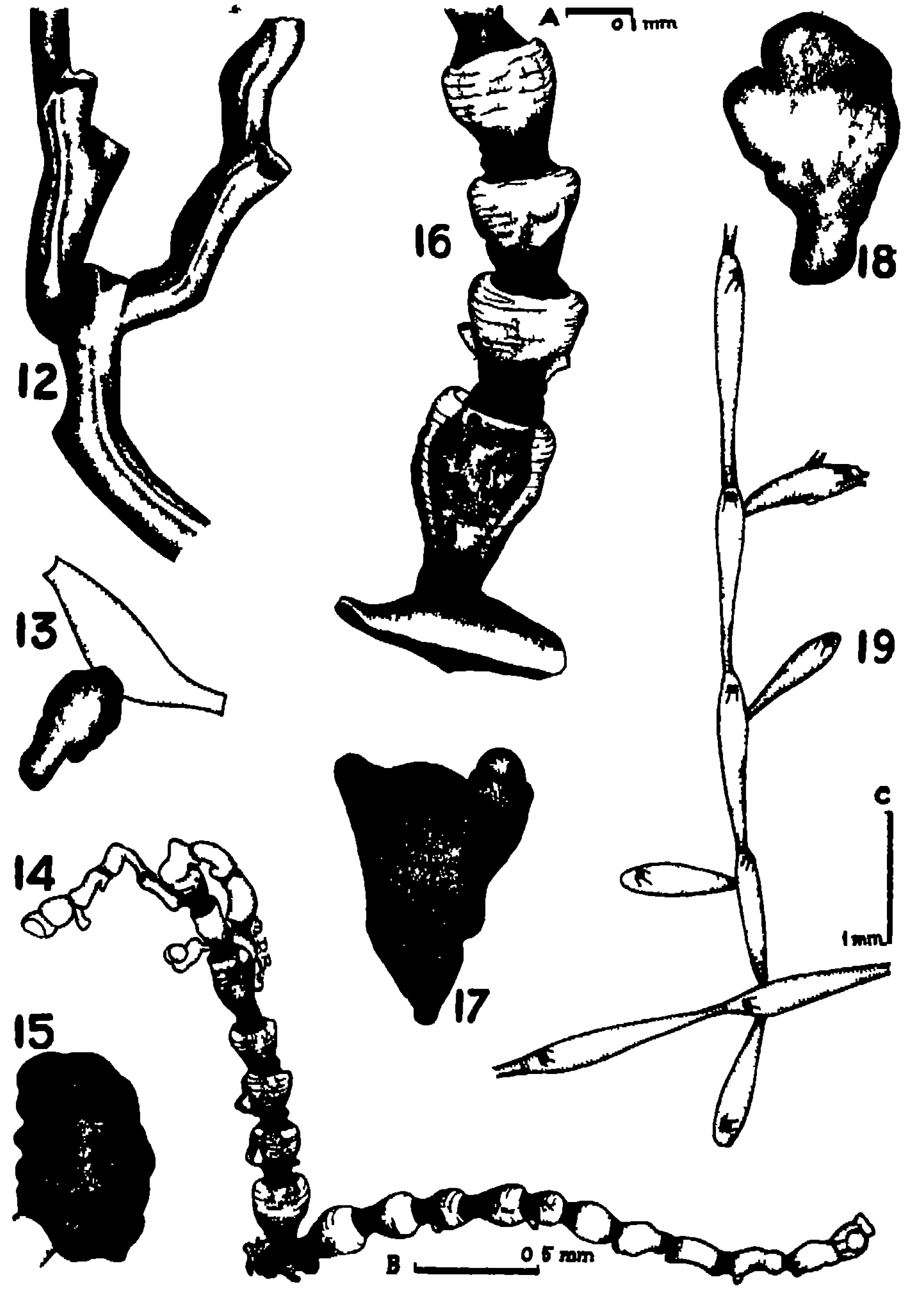
Fig 15 A differently shaped hibernaculum of *Paludicella articulata* Drawn to Scale A

Fig 16 A more detailed view of the basal plate and four lower segments of an *Urnatella gracilis* stalk The brackets on the two middle segments represent broken off buds Note the urn shape of the segments Drawn to Scale A

Fig 17 Another differently shaped *Paludicella articulata* hibernaculum Drawn to Scale A.

Fig 18. Still another hibernaculum of *Paludicella* drawn to Scale A

Fig 19. Portion of a *Paludicella articulata* colony showing the regular mode of branching (lateral and terminal) Drawn to Scale C


A 0.1 mm
C
1 mm
B 0.5 mm

paper (p 209) prefers the latter classification because the forms of the colony and two types of statoblasts are so much like those of *Plumatella repens* var *emarginata* The present writers prefer the other classification (*P casmiana*) because of the presence of the third type of statoblast (Figs 10 11) Should this peculiar transparent thin walled type be found in other *Plumatella repens* varieties then *P casmiana* unquestionably would be listed as a variety of *P repens*

Both Toriumi (1942b) and Rogick (1941 1943) pictured the zoarium and two distinct types of floating statoblasts (floatoblasts) The present paper shows the third type of statoblast (sessoblast) By itself the *P casmiana* sessoblast seems indistinguishable from that of *P repens emarginata* Measurements for two ordinary (capsuled as in Figs 8 and 9) floatoblasts are given in Table III The zoarium or colony and the sessoblasts of *P casmiana* and *P repens emarginata* are very similar The floatoblasts of *emarginata* when seen in edge view are flatter on the dorsal than on the ventral side and the dorsal side of the capsule is much more covered by the float than in *P casmiana* Compare Figs 3 4 5 and 7 8 9

Plumatella casmiana occurred in samples #558 and #613 from Michigan and Indiana respectively Kenk (1949 pp 34 57) reported this species from a pond in southern Michigan and Rogick (1941 1943) from Lake Erie (Ohio and Canada) Foreign localities from which it has been reported are Formosa Japan U S S R and West Java

Plumatella repens var emarginata

The *P repens emarginata* zoarium and sessoblasts are similar in appearance to those of *P casmiana* The zoarium is closely adherent encrusting tan to dark brown in color The zoids are noticeably keeled The floatoblasts are elliptical slightly flatter on the dorsal side than on the ventral (see Fig 5) The dorsal side float covers more of the capsule than does the ventral side float (see Figs 3 4) Measurements of several typical statoblasts are given in Table III

This variety occurred in a number of Michigan Indiana Pennsylvania and Utah samples as listed in Tables I and II It is widely distributed over the U S A and elsewhere in the world and has been reported by many workers Some of its interesting distribution records in foreign localities are Africa Asia (India Java Sumatra Malay Peninsula) Europe (Belgium Czechoslovakia England France Germany Hungary Ireland Italy and Russia)

Plumatella repens var jugalis

The confused status of the geminate *jugalis* form was discussed in an earlier study (Rogick 1941 pp 214 219) Very likely it is not a distinct variety but the growth form of one of the other *P repens* varieties Since the problem of its taxonomic status has not been solved the above unsatisfactory classification must be used

This form has been reported only a few times since its discovery in Essex England by Allman in 1850 The present specimens were few in number and came from sample #558 (Michigan) The other North American (Ohio and Canada) collection sites for this form are in Lake Erie (Rogick 1935 pp 253 254) There it occurred in considerable abundance

Plumatella orbisperma

This species has been recorded only once in literature—in 1882 by Kellicott from a pond on the border of Little Traverse Bay Michigan Unfortunately it was incompletely described by Kellicott (1882 pp 227 228) Only its nearly circular or orbicular statoblast was pictured The statoblast measured about * 325 mm x 360 mm with both sides nearly equally convex The ectocyst was described as colorless but not so thick as in *Hyalinella punctata* The tentacle number was given as about 60 The description of the colony is inadequate so one can not really be sure to what genus this form belongs Its floatoblasts very closely resemble in measurement and general appearance those of *Stephanella hina* which to date has been recorded only from Japan by Oka (1908) and Toriumi (1942a) However *Stephanella hina* is described as having fewer tentacles (36–40) and has a sizeable ectocyst The present writers have not found Kellicott s species but it would be an excellent idea for any collector who finds this form in the future to make a more detailed study of the species particularly of the zoid anatomy and the zoarium growth habit

SUMMARY

1 Five bryozoan species were found in nine collection samples Of these nine samples five were from new Michigan localities two were from Indiana one from Pennsylvania and one from Utah

2 A revision of identification and compilation of a list of previously reported Michigan Bryozoa is included To date 11 species and varieties have been recorded from Michigan The present study adds two more to the Michigan list *Urnatella gracilis* and *Plumatella repens jugalis*

3 *Paludicella articulata* was the most abundant bryozoan occurring in the Michigan and Indiana collections

4 *Urnatella gracilis* was the next most abundant in the Michigan and Indiana collections

5 *Plumatella repens emarginata* was the third most abundant form and occurred in the Michigan Indiana Pennsylvania and Utah samples

6 *Plumatella casmiana* occurred in a Michigan and Indiana collection and was not especially abundant

7 *Plumatella repens jugalis* occurred in very small quantity in one Michigan collection

8 A *Plumatella casmiana* sessoblast is pictured for the first time but is indistinguishable from that of *P repens emarginata*

9 *Plumatella orbisperma* Kellicott 1882 is briefly discussed

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THE OHIO JOURNAL OF SCIENCE

VOL L JULY 1950 No 4

CONSERVATION IN THEORY AND PRACTICE[1]

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More than one speaker I suspect has submitted a title under stress and then when the grim business of preparation began has opened his dictionary to see exactly what he is to talk about Following this precedent I find half a dozen meanings for the word theory and more than three times as many for the word practice Curiously I find too that when these words are used together it is in an antagonistic sense In such instances it is the word theory which suffers for it is used to mean not a body of principles but speculation and guesswork Since our civilization accepts the achievement of power whether social political or economic as a practical accomplishment and a commendable one any criticism or opposition can be damned out of hand as being theoretical speculative irresponsible and visionary Not to be practical in the accepted sense can be a very bad thing indeed and to call anyone a theorist seems to dispose of him effectively

For a long time those excellent fellows the sport fishermen were convinced that poor fishing could be remedied by closed seasons catch limits and the breeding of fish in hatcheries Any suggestion to the contrary was dismissed as theory Then gradually fishermen began to learn of the importance of clean water as a habitat for fish of the enormous reproductive power of fish in good environment and of the extent to which our inland waters have been polluted by sewage industrial waste and silt from eroding farm lands

The resulting protest has taken on the character of a minor political earthquake Sportsmen have mobilized to demand that our rivers and lakes be made clear again Now this is an expensive request to those who have so long used our streams as open sewers As a matter of fact they have a reasonable and honorable defense for the public which has so long tolerated this abuse is as guilty as they and should be made to shoulder part of the burden But the interesting fact is that in the heat of battle the first defense was to reach for a deadly weapon—the word theory The fishermen who demanded an end to pollution were called theorists although they include men from all walks of life It was amusing to see in the newspapers a fair cross section of our population thus labelled on the bland assumption that if you call a man a theorist you are effectively rid of him

Even those who should know better fall for this I recall a congressman who had considerable respect for science One day he asked me point blank if it would not be a good thing to prohibit the growing of wheat in the semi arid country west of the 100th meridian where the Dust bowl lies Knowing the mischief which had resulted from this practice it was a great temptation to say Yes of course and have done with it But as a scientist I was familiar with the diversity of soils and other conditions in this area In all honesty I had to qualify my answer Unfortunately my host was not a scientist He was a politician though an enlightened one He couldn t be bothered with details however simply they were presented - He wanted an answer in the good Christian tradition of "Yea, yea, and nay, nay," and held forth at length on the need for a lexicon which would translate science into black and white for the benefit of his kind

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[1] Presidential address delivered before the Ohio Academy of Science at Capital University Columbus Ohio April 28 1950

Now this particular congressman had performed a considerable public service by coining the word "gobbledegook" in protest against the obscure and pretentious language that had recently became so popular in government documents—"directives," "implementations," and the like But there is a vast difference between inflated, involved, and misleading language and the plain description of a complicated scientific situation For all his good intentions my friend was too impatient to make the distinction In objecting to scientists not because their theories were wrong, but because they were too complex, he allied himself with his political enemies who would gladly discredit theory because the truth might interfere with their personal schemes

It is a curious fact that while the average man can be readily prejudiced against theory as something impractical and speculative, he has a great appetite for speculation, and a great weakness for speculative theories as a guide in his most common actions Countless millions have shaped their conduct and established their values in conformity with intuitive systems of belief which not only have not been, but cannot be, tested with the same simple rigor that applies to scientific theory

Even that most ruthlessly practical and realistic of conquerors, Ghenghis Khan, who tolerated all religious faiths among those spared by his sword, considered it necessary to formulate a system which he called the Yassa—some twenty-two statements of spiritual and practical belief The activities of Hitler along this line are too recent to require description, and were carried to the absurd point where they ultimately crippled vital scientific research in Germany Even Soviet Russia, which has exalted science into a religion, is allowing the party line to determine what is true and false in genetics, to say nothing of art and literature By this view biological truth is no longer a matter of open inquiry and free agreement among scientists of all nations To my mind this is the most tragic and decisive symptom of a barrier between East and West If the same kind of nonsense spread to the physical sciences, we would benefit by the resulting paralysis in Russia, as we did in the case of Hitler, but I doubt if the Kremlin will go that far

Actually there are signs of a reaction against science in our own civilization Certainly there is revolt against scientists and scientism It began some years ago in England with the proposal for a science holiday, to permit society to catch up with technological change It has been continued vigorously by Hutchins and his disciples in the Great Books movement True, Hutchins does insist on human values and the need for intelligence, and he has given ample financial support to scientific research at Chicago But he has some of the qualities of a highly literate, sharp-tongued, and extremely clever demagogue Within the month I heard him condemn the social scientists for teaching trash, and when asked what he meant by trash, he replied "facts!"

On the best-seller list just now is Standen's new book, "Science is a Sacred Cow"—another hint of the gathering reaction With devastating flippancy it points out the limitations of science and of scientists This is an oft-told tale which the scientist can well afford to read again But if it coddles the popular delusion that there are short cuts to natural truths, it can do mischief I must admit that there are scientists who are uneducated, unaware of their premises, naive in their notions of method and of truth But this will hardly stand as a mass indictment, with physicists, for example, concerned as they are at the use to which their discoveries have been put

If the practical man has a contempt for theory I suspect it to be a front for his fear, and the more vehement his expression of contempt, the greater his fear of the power which lies in theory Assuredly there is no more powerful agency at man's disposal than theory Theory is something to be afraid of, unless it favors his immediate schemes

The practical man, of course, is glad to use such bits of theory as he needs for his purpose I once met a gentleman who has on his payroll some of the ablest theorists in the country—he cannot do without them But I found him quite uninterested in discussing an ancestor of his who had some stimulating ideas on the subject of industry, agriculture and society After all, great grandfather had raised some very uncomfortable as well as important questions

The current wave of dam building illustrates the tendency to limit the use of theory to what seems at the time practically advantageous, while ignoring the broader aspects of theory which are not immediately convenient The effect can be serious Just recently two dams which seemed to comply with all the necessary requirements had to be breached to avoid the danger of disastrous floods downstream The designer had taken no account of stream-gauge data in the watershed, though he followed the rules in everything else A trained hydrologist fortunately caught the defect in time to save lives and property Both men were using theory, but that of the first was too circumscribed

I recall, with no pleasure whatsoever, being invited to a meeting to promote the Grand River dam in Oklahoma, later built at great expense I was all in favor of keeping as much transient water in Oklahoma as possible, but took pains to explain that land-use patterns in the watershed would have to be studied, perhaps modified if the reservoir were to be kept from silting and the dam from becoming a flood menace The promoters were much incensed and made that fact only too clear They got rid of me, got the money, and built the dam Since the dam was completed there has been at least one serious flood, and so much siltation that farmers are being begged to practice soil conservation The practical boys got their dam without undue delay, but theory caught up with them I have never seen the dam No doubt it complies beautifully with all of the requirements of dynamic theory But this is dismembered theory, restricted in scope and worked out without relation to the broader aspects of the problem It is an instance of the precise application of science to detail, and the grossest empiricism with respect to the broad setting

One may sail a lake, or skirt the edge of a coast without considering latitude and longitude The location or even the existence of the poles and of other continents need not concern him But when mariners venture on the broad ocean they must know that earth is a sphere and be able to locate themselves with mathematical precision on this sphere The voyages of Columbus were quickly followed by the perfection of quadrant and chronometer, with consequent rapid advance in astronomy and physics Theory, in truth, is not in antagonism to practice, but inseparable from it It is on this basis that I wish to discuss theory and practice in conservation, conceiving theory not as speculation but as a body of principles

To that end, I shall first summarize the situation that now exists with respect to our resources, then develop briefly the principles upon which any sound future action should be based

To the Europeans who settled what is now the United States, resources seemed inexhaustible Andrew Jackson, in one of his Thanksgiving Proclamations, said they were inexhaustible, and that we would never have unemployment Before that, Jefferson's purchase of Louisiana had been condemned as piling too much on top of plenty, while later Alaska was to be referred to as Seward's Folly

And it was true that some resources which today are of great value—notably trees, water, and wildlife—were honestly regarded as obstacles against civilization, to be got rid of as speedily as possible The log-burnings so well described by Conrad Richter, the gigantic slaughter of bison during the 70's, and the reckless drainage by ditch, roadway, and tile all stemmed from the desire to put more land to plow or pasture

There was no restraining concept of the need for a balance of nature, least of all any notion that man might be a part of nature and thus dependent upon maintaining such a balance Poor Richard's sayings were scripture to our young nation But somehow we paid no heed to one of the most important and profound statements that Dr Benjamin Franklin ever made This philosopher had studied the rate of population increase in the colonies, anticipating Malthus by nearly fifty years As he put it, "There is, in short, no bound to the prolific nature of plants or animals, but what is made by their crowding and interfering with each other's means of subsistence"

He failed to say "plants, animals or men" and was perhaps too discreet to say "plants, men, and other animals" After all, Lord Monboddo's suggestion that human beings had once worn tails was considered outrageous, while the religious dogma of original sin took care of many complications which arose from the fact that our own species has a long pre-civilized and a longer prehuman past Why call man an animal? The earth and the fulness thereof might be God's but there was a general feeling that man had full power of attorney

The medieval Church had held that economic behavior was very much its business Individuals guilty of usury and greed were tried in ecclesiastical courts The Reformation changed all that, and so destroyed the chance that wanton waste of resources might eventually have come to be regarded as a spiritual offense This is actually the position of oriental Taoist belief which regards violence against nature and abuse of the earth as a sin, quite as much as violence against man But the Western World had not undergone the suffering of the crowded Orient and did not realize that, sin or not the abuse of nature would ultimately react against man in a very practical way In theological language, it was not yet ready for this revelation Modern science is having to supply what religious insight missed

With the divorce of religion from economics, the accepted standards of behavior became simply an extension of the rule "Finders keepers, losers weepers" The consequence of this philosophy is shown by the history of a single word "exploitation" To begin with, this was a perfectly respectable term, as it still is among engineers Literally it means unfolding, the turning to practical account of anything But presently it came to mean selfish use And today it is a pungent term of condemnation in the general mind This is no accident One has only to read Angie Debo's account of the frightful waste of gas and oil resulting from the early scramble for quick profits in the Southwest to know why exploitation has become an evil word It is only fair to say that not the technicians, but those who hired them were primarily to blame

It is hard to measure honestly what this attitude has cost us and I for one am less concerned to cry over spilt milk than to undo what mischief we can and get started on the right track The Conservation Foundation has recently published a report to Industry which graphically appraises the present state of our resources The same foundation is today engaged in a nationwide water survey and a worldwide report on soil The Soil Conservation Service, Forest Service, Fish and Wildlife Service, all have marshalled disquieting figures which seem to stand up, despite some criticism

Some of this criticism comes from surprising sources Thus an exceptionally able senior member of one of the older scientific bureaus of the U S Department of Agriculture has been severely critical of our concern over soil erosion He calls erosion a symptom rather than a cause of poor rural economy, and says, correctly enough, that erosion is only one source of soil deterioration But by inference he disparages its importance Because his words have been eagerly quoted by those who would play down the whole conservation movement, I think it fair to point out that he represents a group whose word was law in scientific agriculture until the whole erosion problem blew up in their faces Had that group been psychologically and technically prepared to meet the emergency, would two Presidents—one a Republican and the other a Democrat—have found it necessary to develop an entirely new agency—the Soil Conservation Service? I doubt it

Among the many foresters I know, I have found only one who is complacent about our timber supply, saying, "We have plenty of trees" I am sorry to have to point out that he is a marked man in the profession, having no connection with the growing and management of forests, but close ties with those who exploit them So far as wildlife estimates are concerned, I know of no criticism deserving attention

Even the best of national inventories are based on aggregates of local samples, and no skill of mathematical manipulation is able to give greater accuracy than that of the original sampling For this reason I am inclined to lay considerable stress on my own detailed observations in the field I have worked in all but three states of the Union—Washington, Oregon, and Arizona—as well as the province of Ontario and much of Mexico

The net result of my observations can be stated very briefly ***efficient land use, that conserves and improves the capacity of land to produce, is the exception rather than the rule*** To a trained ecologist poor land use is as obvious as the symptoms of disease to a trained physician, while good land use stands out in notable contrast True, money is often being made from poor land use, but if so, it is at the cost of capital investment Even so cautious an authority as Dr Robert Salter has warned that the great increases in yield from hybrid corn are largely obtained at the cost of soil deterioration The same statement can be made of such other cash crops as soy beans, tobacco and cotton

There can be no question that a marked improvement has been under way for the past fifteen years But neither is there any question that this improvement has been most vigorous not on the best farming lands, but on the poorer It is the hill counties in Ohio and in the South which have taken the lead in good conservation practice, while the rich level lands of the Black Swamp and the cotton belt continue to waste away

I can, of course, speak most definitely of Lorain County where I have been living for the past twelve years This county receives about forty inches of rainfall per year, over 4 000 tons per acre, yet a substantial proportion of farmers are buying city water This county has a minimum of well managed mixed legume pasture, and far too many soy bean and corn fields left bare through the winter months There is little systematic return of organic matter to the soil, and practically no trash farming which would increase water absorption Our studies show that pastured woodlots, with their trampled soil suffer heavily from summer dryness This condition is intensified by the fact that absence of undergrowth permits leaves to be blown away, instead of rotting into absorbent mulch

We have found that about 20 per cent of the county drains directly into highway ditches Except for the rare cases where the drainage slope is covered with improved pasture or protected woodland, this represents a heavy discount on the annual rainfall

The streams of the county suffer from pollution and uneven flow, with resultant damage to fishing With respect to one stream, we know that deterioration can be traced to clearing the headwater forests and thickets Assuming this relation to be general, we have mapped woodlots and stream sources We find some 800 woodlots (mostly grazed) and about 400 stream sources, but of this number only 36 stream sources are wooded This is a meager 10 per cent guarantee of stable stream flow

Such, in brief, are conditions as of today in a fairly prosperous and respectable agricultural county which no one thinks of as marginal In happy contrast are two noted Ohio farms, those of Louis Bromfield in Richland County, and Cosmas Blubaugh in Knox County Both are models of intelligent ecological treatment That of Bromfield is thoroughly analyzed and discussed in his latest book, "Out of the Earth," and I am inclined to agree with Russell Lord that this will be one of the most important agricultural publications of recent years Bromfield has put his land to rich meadow, whose grass and legumes are used for pasture, hay, and ensilage Corn has been eliminated and small grains confined to the necessary minimum of oats and barley required for occasional seeding of meadows Under a new plan oats and barley are added to the ensilage, enhancing its nutrient qualities The deep rooting meadow plants tap the subsoil minerals, while a system of rough tillage conserves moisture and organic matter I have myself confirmed the benefits of this system to land, water, and livestock, and am prepared to accept Mr Bromfield's statement that he is producing meat and milk at a heavy saving Of great importance is the claim that animals and plants are far healthier than under the old system of row crops and grain farming This statement is in accord with much testimony from other sources and deserves the most careful scientific check

The Bromfield farm is an individual enterprise, but there are examples of community patterns of excellent land-use, long antedating the time of science Such are the Pennsylvania Dutch farms, the Igorote terraces between Manila and Baguio, and some of the pre-Conquest areas in central Mexico, of which mere traces persist At best these are few in number and meager in extent as compared to the general pattern of exploitation, world around Yet they serve to show that peace between man and nature is possible

Now these ancient systems of good land use were worked out through generations by the costliest, most painful trial and error On the other hand Mr Bromfield, making use of scientific insight, was able to establish a successful system in less than ten years For those who do not understand the advantages of scientific theory over trial and error I would recommend reading first Mr Bromfield's "Out of the Earth" and then a recent book by George Reeves called "A Man from South Dakota ' Reeves, trained in journalism, a born gambler and a hard worker went at the business of developing his South Dakota ranch as though he were playing roulette Unquestionably he had very difficult conditions under which to work, but at the end of twenty-four years he still seems not to sense that it is possible to conquer nature only on her own terms He had studied some science, true, but nowhere seems to have learned that any landscape, whether farm or river valley, is a great organic entity which must operate in accordance with the principles of the balance of nature His experience is in powerful contrast to that of Mr Bromfield

This brings us finally to the question of what principles underlie the wise use and care of natural resources First I should place the fact that any area with its resources and inhabitants is an expression of energy This energy comes primarily from the sun, is fixed by green plants in the form of organic compounds, and thereafter channeled through food chains to all forms of life present In the course of this channeling the laws of the conservation of energy apply as relentlessly as in any laboratory experiment or industrial process It is entirely possible for a trained ecologist to judge how efficiently the energy is being transformed and used in any habitat He can read the landscape as a banker reads a financial statement

Let us suppose that stubble is being burned This results in a complete release of all energy and reduction of material to inorganic state On the other hand if plant and animal materials undergo natural decomposition countless forms of life take part in the slow, step by step release of energy This has two consequences Each step affords subsistence to a particular set of organisms The more gradual the change, the larger the number of possible niches which can be filled by appropriate forms of plant and animal life Each in turn performs a role in relation to the whole community, changing it and in general helping better to organize it to sustain future generations of living things One may observe this process in an abandoned field returning to forest or a neglected roadway going back to prairie

As time goes on any area tends to build up to the point where it makes the most efficient use possible of solar energy and the raw materials of earth and air This is the type of virgin habitat which Europeans entered when they settled North America It is still the norm or standard towards which good land use should direct its aim Too often, as we have seen, the effect of human occupation is to disrupt completely this chain of events and not substitute anything constructive for it

Finally, our own species is related to the rest of nature largely through its socially sanctioned forms of behavior It may happen as it did with the Pennsylvania Dutch, that such behavior was arrived at through the long course of trial and error With us, however, the problem is to modify our behavior in the light of scientific knowledge This clearly calls for a wide understanding of the body of principles which lie back of sound land use and for making those principles a matter of social sanction It is at this point that the scientist must enlighten those who formulate public opinion and establish standards of behavior

Technically, these are the artists, poets, writers and publicists of our civilization, to whom falls the task of dramatizing the truth as they see it This was the role of John Steinbeck when he wrote "Grapes of Wrath " Unfortunately, he was at least two removes from the source of truth and while he stirred up public opinion, the net effect had more to do with reforming transient camps in California than with restoring the soil in Oklahoma, whose abuse was the physical basis of his tragedy

Edmund Sinnott has given us a valuable clue in his presidential address to the American Association for the Advancement of Science He spoke on the topic, "Millions of Scientists," pointing out the opportunity for widespread social participation in science His view has been justified, for example, by co-operative land use surveys in England and this country The process can be much more widely extended Such co-operation in science would bring home, as nothing else can, those principles which must guide our civilization if it is to endure

And to his suggestion I would add another, which I think is inherent in our democratic philosophy Call it "Millions of Interpreters" if you like As each individual comes better to understand the principles of which I have spoken, he can, without waiting for the Steinbecks, express the importance of what he knows and so play his part in molding public opinion and establishing new values

I can testify that just such a process is now under way Friends of the Land, the Izaak Walton League, American Forestry Association (and here in Ohio our vigorous Ohio Forestry Association), countless Garden Clubs, and many other lay organizations are learning the truth and telling it

The conservation movement may have a long and difficult way ahead, but it has crossed the divide

THE SPECIAL SYMPOSIUM ON CONSERVATION PRESENTED AT THE FIFTY-NINTH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

CHARLES A. DAMBACH,
The Ohio State University,
Columbus, Ohio

Progress toward scientific management of our natural resources although discouragingly slow at times has none-the-less been remarkably rapid during the past two decades. During this period the number of scientifically trained personnel employed to cope with resource problems has increased many fold and numerous important conservation projects have been completed. In our own state, for example, the number of trained workers engaged in soil, water, forest, mineral and wildlife management and research has grown from less than 50 in 1930 to approximately 250 at the present writing. During the same period such important projects as the Muskingum Watershed Conservancy District with its 14 flood control dams and 10 recreational lakes, greatly enlarged public forest programs and the organization of Soil Conservation Districts in 78 of the 88 counties in the State have been realized.

Considerable progress has also been attained in conservation education. Courses designed to awaken students to an understanding of resource problems were initiated during this period at a number of the privately supported Ohio colleges and universities and in at least three of the state supported universities. The Ohio Conservation Laboratory for prospective teachers and teachers in service was also initiated during this period. This program, conducted by the College of Education of the Ohio State University in co-operation with the State Department of Education and the Ohio Division of Wildlife has provided training to many elementary and secondary school teachers who have established centers of conservation teaching in both large and small school systems in the State.

Although these and many other accomplishments have been attained it is readily apparent that much yet remains to be done. We have made progress on only some of our problems while on others we are still falling behind. Despite notable advances in soil conservation for example we are for the state as a whole still carrying on a depleting type of agriculture. Probably not over 20 per cent of Ohio farms are managed on a self-sustaining basis in so far as soil resources are concerned. While progress is being made on some fronts new problems continue to develop. The growth of the chemical industry in recent years has for example introduced new problems due to the resulting waste products emptied into our already polluted streams. Wildlife management problems too have become more complex because of the ever growing army of hunters and fishermen who seek an equitable share of the wildlife crop produced on farms and the meager area of publicly owned land in the state.

One of our major problems is to so co-ordinate the efforts of the various agencies established to work on conservation programs that the maximum good may be accomplished with the limited funds at their disposal. The recent Ohio Legislature had this objective in view when it enacted legislation establishing a Department of Natural Resources ". . . and to bring into that department, as divisions thereof, the various state agencies engaged in conservation of natural resources and to provide for the correlation of the work and activities within the department so as to avoid and eliminate unnecessary duplications of effort and overlapping of functions. . . ."

This legislation brought into legal status on August 11, 1949, the first unified conservation department in the state and placed Ohio among the select group of states which now handle their resource problems in this manner

The conservation symposium conducted at the recent annual meeting of the Ohio Academy of Science was planned by the Conservation Committee to acquaint members of the Academy and the general public with current conservation problems in Ohio and the programs of the agencies charged with responsibility for their study and management Special emphasis was given to the administrative organization of the newly created Department of Natural Resources and to the program, problems and policies of the divisions of Geological Survey and Water within that department The papers presented at this symposium are herein published as a means of further disseminating the information presented It is hoped that similar symposia may be conducted at subsequent meetings of the Academy so that the work of the remaining divisions of the Department and of other conservation agencies in the state may become better known

ANNUAL MEETING

OF THE

AMERICAN INSTITUTE OF BIOLOGICAL SCIENCE

In Columbus Ohio and the Ohio State University

SEPTEMBER 11 - 12 - 13, 1950

The following Biological Societies will present programs at the A I B S Meeting

American Bryological Society
American Fern Society
American Society for Horticultural Science
American Society for Plant Physiologists
American Society for Human Genetics
American Society of Lymnology and Oceanography
American Society of Naturalists
American Society of Plant Taxonomists
Botanical Society of America
Ecological Society of America
Genetics Society of America
Mycological Society of America
Phycological Society of America
Society for the Study of Evolution
Society of Industrial Microbiologists

THE SEMI-CENTENNIAL OF GENETICS

In Celebration, the Genetics Society of America is preparing a special program for the Columbus Meeting

All members, of Biological Societies not planning programs for the A I B S meeting are cordially invited to attend the Columbus Convention

PROGRAM, RESPONSIBILITIES, AND PROBLEMS OF THE NEW OHIO DEPARTMENT OF NATURAL RESOURCES

A. W. MARION, Director
Columbus, Ohio

Appreciation is expressed for this opportunity to present to the Ohio Academy of Science certain factual information regarding the recently unified Department of Natural Resources here in our own State of Ohio. I am aware that many individuals who hold membership in the Academy contributed a great deal of their own time and effort toward the creation of this unified conservation program.

The movement to create an integrated state department embracing all forms of resource conservation, has actually been in the making for nearly a decade. The idea had numerous, scattered proponents even earlier than that, but within the last half-dozen years the idea really took hold and flourished to such an extent that legislation was introduced in three successive sessions of the Ohio General Assembly relative to the creation of a unified Natural Resources Department.

The Bill which was finally enacted into law was Senate Bill No. 13 of the last General Assembly, and the law became operative on August 11, 1949.

It is perfectly safe to say that when the Bill was finally passed probably no one was completely satisfied with the enacted version, although most Ohioans believed that a start had been made in the right direction. At this point let me say that after nearly nine months of working under the provisions of the Bill, probably no one realizes more fully than I the numerous deficiencies in it, but at the same time I have the utmost confidence that these deficiencies can be corrected, and the Bill further clarified without any serious threat to preserving the character and intent of the Act.

Numerous well qualified citizens of Ohio served on various committees to advise and review the legislation which was drafted prior to its introduction in the General Assembly. An effort was made to give persons directly interested in each of the several basic resources a voice in shaping the final broad concept of the Bill. On these committees were people interested in soil and agriculture, in geology, in wildlife problems, in parks and recreation, in the use of water from the standpoint of agriculture, industry and municipalities. Expert engineers also served on these committees. Whatever might be said for or against Senate Bill 13, it probably did reflect the attitude and the understanding of a wide range of people representing a fairly typical cross section of our entire population.

Senate Bill 13, as it became law, provided for the establishment of seven divisions in the Department of Natural Resources. These included four existing agencies and three new divisions created by the law itself. The existing agencies which were moved over into the new Department included the Division of Water, formerly listed as the Water Resources Board, the Division of Geological Survey, the Division of Forestry, formerly a section of the Agricultural Experiment Station, and the Division of Wildlife, formerly known as the Division of Conservation and Natural Resources. The three new divisions created included the Division of Beach Erosion, the Division of Lands and Soils, and the Division of Parks. A little later, I shall attempt to outline briefly for you the functions vested in each of the seven divisions.

The Natural Resources Commission established by the law, has a total of nine members. Seven of these members are appointed by the governor for seven-year terms on a staggered-term basis, and not more than four of these seven men may be members of the same political party. The other members in the Commission are designated to serve by virtue of the positions they hold—one being the Dean of the College of Agriculture of the Ohio State University, and the other, the appointed director of Natural Resources The director, however, is not authorized to vote on matters under consideration

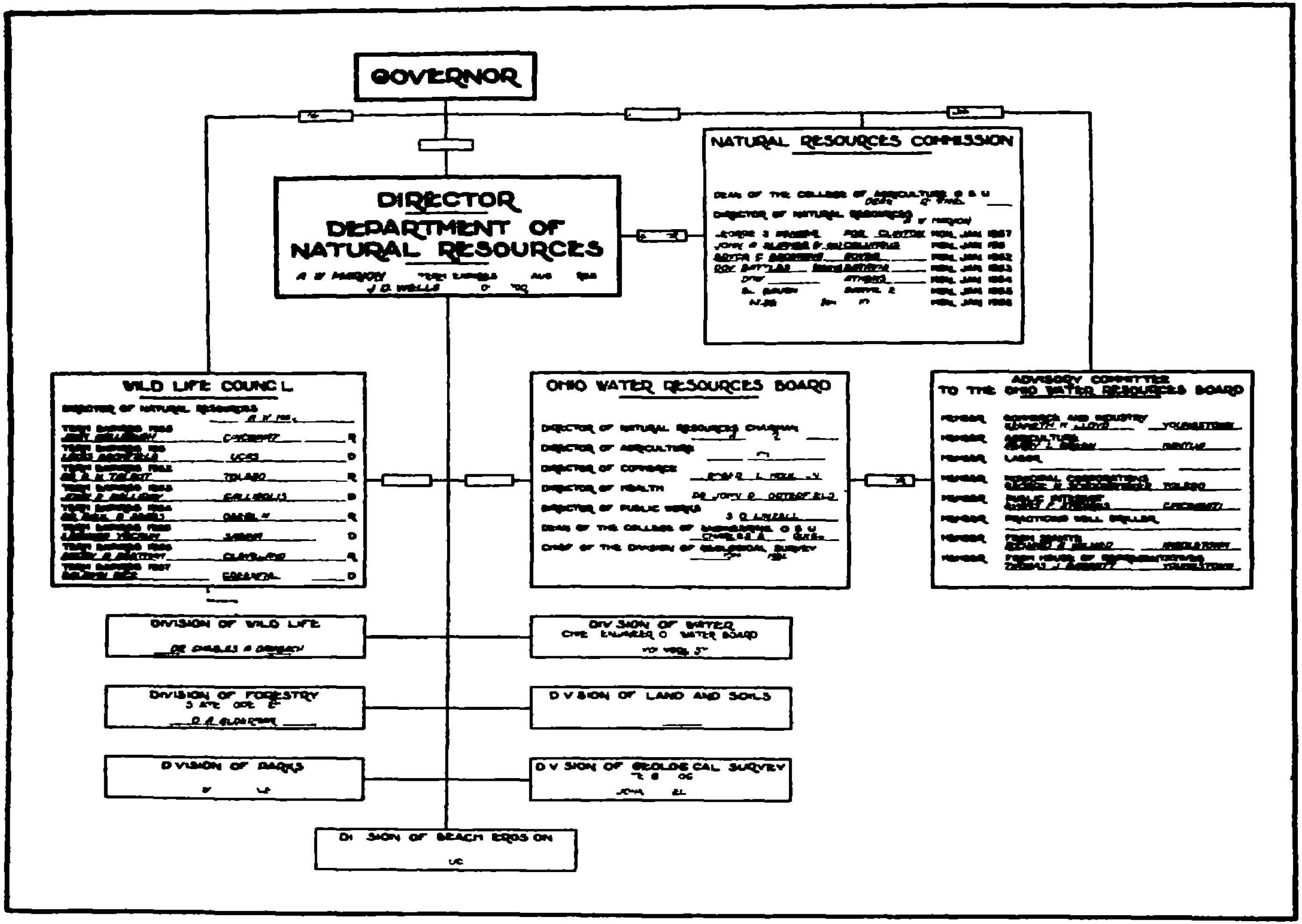
It was not my intention to enter into a discussion of personalities, but I do feel that to point out and name the initial membership of this Natural Resources Commission, will indicate to you the sincere attempt of the Governor to call upon highly qualified men to give public service, as a policy-making Board for this new, unified Department Those who now serve on this Commission are Mr Roy Battles, widely known farm director of Radio Station WLW, Mr C D Blubaugh, of Knox County, one of the pioneer practicing soil conservationists in the State of Ohio, Mr Bryce C Browning, nationally known secretary of the Muskingum Watershed Conservancy District and recognized as an authority on problems of water and forestry, Dr C L Dow, Professor of Geology and Geography, of Ohio University, Mr Lew C Reese, one of America's outstanding industrialists whose Scio Pottery and management-labor relations has commanded national attention, Mr John A Slipher, widely regarded as one of the nation's outstanding practical soil technicians, and Mr George Wenger, well-known industrialist and sportsman The Commission exercises no administrative function but advises with and makes recommendations to the Director with regard to plans and programs for the management, development, utilization, and conservation of all of the natural resources in the State, it advises and makes recommendations on methods of co-ordinating the work of the several divisions in the Department, it may consider and make recommendations upon matters of policy which the Director may refer to it and hold public hearings on the same, and it may submit biennially to the governor such recommendations for changes in the Conservation Laws as may be deemed desirable The members of the Commission serve without compensation, but are reimbursed for the actual and necessary expenses incurred in the performance of their duties A majority of the membership of the Commission is necessary for a quorum

The Bill, as it was passed, provided that there shall be a Director, appointed by the governor for a period of six years His appointment shall be concurred in by the Natural Resources Commission and approved by the Senate

The Bill provides that the Director shall formulate, determine, and institute the policies and programs of the Department and shall approve any contracts or agreements involving any of the seven divisions The Director is empowered to correlate and co-ordinate the work and activities of the seven divisions so as to avoid unnecessary duplication of effort and overlapping of functions

In addition two advisory boards were created by the Act, namely, the Wildlife Council and the Water Resources Board There was also named an Advisory Board to the Water Resources Board, representing all affected segments of our population The Director may create advisory boards for the rest of the Divisions, if he sees fit to do so The Director is authorized to accept and expend gifts, devises and bequests of money, lands, and other properties on behalf of the Department or any of its divisions He shall also have the power to publish and sell or otherwise distribute data, reports and information With the approval of the governor, he may take action in behalf of the State for the appropriation of private property for public use, under the existing sections of the General Code, relating to such procedure The Director of the Department shall have the right and authority to enter into co-operative or contractoral agreements with the United States Government, or any of its agencies or departments, or with any other body politic for the accomplishment of any of the purposes of the Act

In order to maintain experienced personnel in key positions, Senate Bill 13 provides that the State Geologist, the Chief Engineer of the Water Board, the State Forester, and the Conservation Commissioner, should continue to hold their


GOVERNOR
DIRECTOR
DEPARTMENT OF NATURAL RESOURCES
J D WELLS
NATURAL RESOURCES COMMISSION
DEAN OF THE COLLEGE OF AGRICULTURE O S U
DIRECTOR OF NATURAL RESOURCES
WILD LIFE COUNCIL
DIRECTOR OF NATURAL RESOURCES
OHIO WATER RESOURCES BOARD
DIRECTOR OF NATURAL RESOURCES CHAIRMAN
DIRECTOR OF AGRICULTURE
DIRECTOR OF COMMERCE
DIRECTOR OF HEALTH
DIRECTOR OF PUBLIC WORKS
DEAN OF THE COLLEGE OF ENGINEERING O S U
CHIEF OF THE DIVISION OF GEOLOGICAL SURVEY
ADVISORY COMMITTEE TO THE OHIO WATER RESOURCES BOARD
MEMBER
COMMERCE AND INDUSTRY
AGRICULTURE
LABOR
MUNICIPAL CORPORATIONS
PUBLIC INTEREST
PRACTICING WELL DRILLER
FROM SENATE
FROM HOUSE OF REPRESENTATIVES
DIVISION OF WILD LIFE
DIVISION OF WATER
CHIEF ENGINEER O WATER BOARD
DIVISION OF FORESTRY
DIVISION OF LAND AND SOILS
DIVISION OF PARKS
DIVISION OF GEOLOGICAL SURVEY
DIVISION OF BEACH EROSION

positions as chiefs of their respective divisions after the effective date of the Act Concerning new division chiefs for the divisions created by the Act, the law provided that these were to be appointed by the Director with the approval of the Natural Resources Commission

To further strengthen the security of trained personnel, the law provides that any person holding a position within the classified Civil Service of the State, would be transferred to an equal position and grade in the new Department Persons who were holding employment in the divisions or departments not previously subject to Civil Service were placed without examination, in positions commensurate with the duties, seniority and compensation of their previous employment

I had originally thought to outline some of the work of all of the seven divisions of the Department, but since Mr Melvin of the Geological Survey and Mr Bernhagen, of the Division of Water, are to appear on this program and tell of the work of their agencies, I shall refrain from discussing the importance and work of these two divisions

The Division of Beach Erosion was created for the purpose of engaging in projects and in lending co-operation to other agencies engaged in projects for the protection of the south shore of Lake Erie from the severe damage which occurs as a result of shore erosion This work was formerly carried on under the Ohio Department of Public Works, and its program is virtually unchanged insofar as background of legal authority is concerned One of the principal limitations with regard to the Division of Beach Erosion is the character and cost of the work involved The laws under which this division functions, more or less restrict its projects and programs to those places along Lake Erie where public benefits are involved Its program does not encompass the protection or rehabilitation of privately-owned lands This division has jurisdiction and control of the submerged lands belonging to the State under the waters of Lake Erie and the minerals they contain The Division of Beach Erosion is headed by Mr F O Kugel, a veteran engineer, who spent many years in this work with the Department of Public Works

The Division of Parks, to quote directly from Senate Bill 13, "shall have the right, power, and duty to create, supervise, operate, protect and maintain a system of State parks and to promote the use thereof by the public Within 30 days after the effective date of this Act, all state properties the major function of which is park in nature, shall be classified and transferred to the Department, except roadside parks, of the Department of Highways and lands of the Archaeological and Historical Society"

In order to understand the complexity of the problem involved in meeting the terms of the law, it is necessary to have some knowledge of Ohio's widely-scattered park system, prior to the establishment of this new Department

A century or more ago, the State of Ohio engaged in building a great network of canals throughout the State, including feeder reservoirs for water supply After the railroads supplanted the canals as a means of transportation, these lands and waters remained under the ownership of the State Some of these reservoirs were continued under the management of the Department of Public Works with much of the rest of the canal system Most of the reservoirs, however, were turned over to the former Division of Conservation, primarily, for the public recreation and the fishing values involved Over the years, most of the desirable state-owned lands adjacent to the larger areas of water were leased to private individuals for a wide variety of uses The State, however, retained custody of the water, itself to permit boating and fishing and frequently the term "state park" was applied to such areas, although there was actually little park value involved

In recent years, financed by both general revenue and fishing license funds, the former Division of Conservation had constructed a number of headwater lakes, primarily for additional public fishing waters On most of these areas, a narrow access strip was acquired around the edge of the lake, and occasionally a few acres of ground to permit the construction of a shelter house and related facilities However, these, too, fell far short of meeting the accepted definition of a State park, even though they were frequently listed and publicized as such

During the last quarter of a century, the Division of Forestry had acquired by purchase or co-operative agreement almost 150,000 acres in the State Forest System The laws under which the Division of Forestry operated, were wisely written to permit acquisition of land not only for forest purposes, but for scenic, scientific and recreational values as well Many of the finest potential park areas in the State thus passed into the cusotdy of the Division of Forestry Recognizing the growing public interest and demand for outdoor recreation, this agency in recent years had advanced the development of public use facilities on the lands it operated and controlled When Senate Bill 13 became law, these recreational facilities which had been thus far developed by the Division of Forestry were to pass over to the management and operation of the Division of Parks There are numerous problems involved in arriving at a sensible basis for such a transfer of program and authority, since the recreational work had been developed as only one phase of a broadly integrated program of good land use on the State forest system In other words, in most instances, the same personnel, the same supervision, and the same equipment were used to carry on the recreational program in conjunction with the general forestry program on these areas involving timber harvest, reforestation, fire control, road maintenance and similar activities

The new Division of Parks has a tremendous problem ahead of it It has considerable money at its disposal for the construction and development of new areas and new facilities but it is sorely handicapped at present by lack of adequate operation and maintenance funds The Division of Parks is directed by Mr V W Flickinger, formerly the Chief of the Division of Lands and Waters of the State of Iowa This Division has a real job ahead of it in development of a long-range program designed to meet Ohio's future park needs

With relation to forestry in the new unified Department, the Division of Forestry was transferred from its former place with the Agricultural Experiment Station into the new Department with scracely a change in its day-to-day program Only minor changes were made in the forestry laws of the Ohio General Code Technical forestry research was left as a function of the Agricultural Experiment Station Forestry had been unique among State agencies in the past, in that it had no Columbus office, its principal office being at the Wooster Experiment Station and its southern Ohio office at Chillicothe Until expanded office facilities are available here in Columbus, this arrangement must still prevail

The Division of Wildlife carries practically all of the programs formerly vested in the Division of Conservation and Natural Resources, except those activities formerly conducted under its Inland Lakes and Parks Section When Senate Bill 13 was passed it provided that the former Conservation Commission, the policy making board in the past, was to maintain its identity and be known as the Wildlife Council Its principal function is to establish rules and regulations concerning thet aking, propagation, habitat restoration and federal projects relating to fish and game, and to advise with the Director of Natural Resources in all matters pertaining to the planning and developing of the programs and policies of the Division of Wildlife

The law provides, as in the past, that money received from the sale of hunting and fishing licenses shall be used for the operation of the Wildlife Division, and it establishes certain maximum percentages which may be used for administration and law enforcement

The seventh division which was authorized under Senate Bill 13, is the Division of Lands and Soil This Division has not yet been established, and probably will not be until we are in a position to provide it with office space, equipment, and qualified personnel This Division is not intended to replace or to do away with any existing agency working in the field of Soil Conservation Rather, it is intended to correlate the activities and to encourage and assist all other agencies which may be faced with problems relating to soil conservation The primary function of this division will be to inventory the land resources of the State and to provide technical and mechanical assistance to existing Soil Conservation Districts

While no one can safely predict what future legislatures will do, there is at this time considerable sentiment that the present Division of Reclamation in the Department of Agriculture, dealing with strip mine lands, might well come over into this new Division of Lands and Soils in the Department of Natural Resources Such a change, of course, could only occur by legislative enactment

SUMMARY

It will be seen from the foregoing that there is quite an elaborate legal framework now established for the new Department of Natural Resources Yet, I believe that all of us who try to think the matter through, must recognize that while this legal framework may be both necessary and desirable, it is no guarantee in itself for the success of the new unified department Rather, we must view it as a means toward an end, and not as the end objective in itself

We must be broad enough, and honest enough, to recognize that it is going to take wise council, constructive long-range planning competent sincere personnel, and a substantial amount of money, to do the things which we all know should be accomplished here in our own State

We are currently faced with the problems incident to an increasing population We are faced with the perpetual problem of maintaining the fertility and productiveness of our agricultural lands, and we are likewise faced with finding an intelligent answer to the problem of our growing areas of marginal and submarginal lands throughout the State Yet, I believe that whether it happened to be Senate Bill 13, passed last year, or some other bill, passed within the next decade or so, we would ultimately have come to a similar effort to unify our thinking and action, for the present and future welfare of our citizens depends upon the conservation and wise use of our basic resources Through the findings of science, we have come to the realization that we cannot hope to save one of our renewable resources without saving them all Neither can we destroy any one resource without doing damage and injury to another equally important resource Science has led the way in pointing out the affinity of soil, water and plants, upon which life itself depends

In the last half century, we have gone far in development of the industrial and technical phases of our national economy We have streamlined and integrated business and industry to secure greater efficiency in production, and better distribution of goods It is inevitable that, sooner or later, we would come to the same philosophy in the management of our basic natural resources

I believe, too, that this attempt to unify and integrate our efforts in the field of resource conservation represents another mile post along the road of our mental and spiritual progress A hundred years ago in this country of ours, we abolished the institution of human slavery, 50 years ago, we began to pass social legislation for the protection of our less fortunate elements of population Perhaps, this current rising interest in the welfare of our basic resources is evidence that we may be widening our spiritual horizons sufficiently to recognize that mankind does not own the earth, but that each generation, is destined to serve as a trustee of these basic resources, for generations yet to come

I realize fully my own limitations in the tremendous work that lies ahead, and will certainly welcome help and suggestions from members of the Ohio Academy of Science

PROGRAM PROBLEMS AND POLICIES CONCERNING MINERAL RESOURCES IN OHIO

JOHN H MELVIN
Chief Division of Geological Survey

Twelve years before the founding of this great University whose centennial we observe today W W Mather Ohio s first State Geologist wrote in his report of 1838 The primary object with the Legislature in authorizing the Geological Survey of the State was to develop its natural resources with a view to their application to the economical purposes of life

Down through the years the program of the Survey has been based on that philosophy It has always been a research organization dedicated to discovering and making known scientific data on the mineral resources and geology of Ohio Today that program remains unchanged The staff serves the public by regular publication of reports on its findings by letter telegram or telephone and by personal interview The Survey s extensive files of physical and chemical data its many and varied publications and maps and the helpful suggestions of its staff of specialists are available to all who are interested in industrial development public improvements and conservation of resources

The new Natural Resources Law defines a specific program in considerably more detail than any previous act It says

> SEC 802 * * * The division of geological survey department of natural resources shall
>
> *a* Collect study and interpret all available information pertaining to the geomorphology stratigraphy paleontology mineralogy and geologic structure of the state and shall publish reports on the same
>
> *b* Collect study and interpret all available data pertaining to the origin distribution extent use and valuation of mineralogical and geological raw materials and natural resources such as clays coals building stones gypsum limestones and shales for cement and other uses petroleum gas brines saline deposits molding sands and other natural substances of use and value excluding only those pertaining to water usable as such for agricultural industrial commercial and domestic purposes but not excluding other rock fluids such as natural and artificial brines and oil well fluids
>
> *c* Make special studies and reports of resources of geological nature within the state which in its discretion are of current or potential economic or educational significance The division of geological survey at its discretion shall examine the technological processes by which mining quarrying or other extracting processes may be improved or by which materials now uneconomical to exploit may be extracted and used commercially for the public welfare
>
> *d* Make store and have available for distribution maps diagrams profiles and geologic sections portraying the geological characteristics and topography of the state both of general nature and of specific localities
>
> *e* At its discretion or at the request of other agencies of the state government advise and consult with representatives of those agencies on problems of geological nature

There are some other minor provisions and the section on geology closes by stating

> SEC 802-3 Nothing in this act shall be construed as limiting the authority of the chief of the division of geological survey to investigate survey interpret and report matters relating to the geological or mineralogical conditions of the state or to technologies pertaining to them to the end that industry commerce education public health and recreation may be advanced

There are features of other acts which do limit the activity of the Survey however, particularly the lack of certain provisions in the biennial appropriation acts

Over 30 separate projects are being carried forward at the present time Surface geology studies are progressing in Adams, Athens, Coshocton, Gallia, Hocking, Lucas, Monroe, Morgan, Perry, Stark, Tuscarawas and Washington counties Such projects include studies in stratigraphy, paleonotology, geomorphology, structure and particularly the economic geology of the area

Editorial work is progressing on a voluminous manuscript by Dr Wilbur Stout on the Monongahela formation of Ohio and one on the Mississippian formation by Dr J E Hyde

The coal section of the survey is engaged in a continuing, long range program of accumulation and correlation of data on the geology, thickness, composition, and reserves of Ohio coal desposits

In co-operation with the Engineering Experiment Station of the Ohio State University, a study is being made of the uses of Ohio coals as a source of synthetic liquid fuel Another co-operative project with the Station is a detailed field sampling and laboratory analytical study of the Meigs Creek or No 9 coal Vast reserves of this coal exist in Ohio but certain types of treatment or beneficiation may greatly improve its quality

The oil and gas section is also engaged in a long range program of collection detailed information on the more than 200,000 wells which have been drilled in Ohio

The section prepares each year a review of oil and gas drilling activity in the State

A thorough study of oil and gas in Perry County is being made and a chapter on the subject will be incorporated in the county bulletin

Industrial minerals are the mineral resources other than the metallics and the mineral fuels Clay, salt, limestone and dolomite, sand and gravel, gypsum, and sandstone are important Ohio industrial minerals

Progress is being made on the study of the Sharon Conglomerate, a source of silica used by a number of Ohio industries

Detailed studies of the joints in the limestones of Western Ohio is being carried forward and may have a number of future economic applications

Chemical analyses of over 130 limestone samples from Eastern Ohio have been completed and a bulletin on the subject is in preparation

A reconnaissance study of the sand and gravel despoits of the northern half of Ohio has been made and a report issued Much additional work is needed on these resources

A co-operative study with the Cleveland Illuminating Co on salt and brines of Northern Ohio is being carried on

Work on a new Geography of Ohio is going forward with publication expected in early 1952

A limited amount of work is being done on the geology of Lake Erie and it is hoped that additional studies can be carried on during the coming year

Collection of cores and of oil and gas well cuttings is continuing and studies of these sub-surface materials is under way

Approximately one-third of the time of the entire staff is devoted to public service This includes the answering of inquiries by telephone, telegram, letter, and personal interview, the preparation of news releases, technical papers and pamphlets of general interest, service on various boards and committees, and the presentation of talks and reports before numerous organizations

So much for the present program of the Survey Of course we have some problems too Through the years the major problem has always been an adequate appropriation to meet the responsibility imposed by law In 1838 Mather closed his report on the following optimistic note

"Ohio has never yet retraced her steps in any work of public utility that she has undertaken, and the idea can scarcely be entertained, that she will withhold the appropriation of a few thousands, by the expenditure of which millions will be returned to her citizens"

Appealing to the far-sightedness of our people has not always had the desired result, however At one time in the depth of the depression the entire appropriation was discontinued and Dr Stout carried on for some months without any funds whatsoever

Today our appropriation is not adequate to meet the responsibility of the new law Nor is it adequate to serve our people in the way that the citizens of many other states are being served geologically Illinois is investing ten times as much each year and 19 other states carry on more extensive programs than does Ohio This in spite of the fact that though 35th in size we rank 9th in value of raw minerals produced This is our major problem

Another problem, regardless of appropriations is the matter of space and location For over half a century the Survey has been located in Orton Hall, the geology building on the Ohio State University campus This building, constructed in 1893 houses, in addition to the University's Geology Department, the Geological Museum and the Orton Memorial Library of Geology

If the State constructs a Natural Resources building will it provide the proper atmosphere for continued basic research, an atmosphere which certainly exists on a great University campus? If the Survey remains in Orton will its growth be stunted by the lack of Laboratory facilities so essential to implementation of its assignments under the new law? This too is a perplexing problem facing your Survey

Personnel is not a pressing problem at the moment Ohio has always had her share of outstanding scientists, including geologists Over 50 applications for summer work or full time employment have been received in recent months The state is in the process of establishing a modern civil service classification system and apparently geologists will be properly recognized The personnel problem is merely the appropriation problem in disguise

The Division of Geological Survey, like its predecessor, the Geological Survey of Ohio, operates on a broad policy of careful and efficient expenditure of the taxpayers' money Co-operation is the answer to a limited budget If Federal State or industrial organizations are satisfactorily performing functions assigned to the Survey I see no need for duplication Our relationships with the Engineering Experiment Station of the Ohio State University, the Geology Department, the Division of Mines, the Division of Water, the Highway Department, the Industrial Relations Department, the Commerce Department, the various mineral associations, the U S Geological Survey and Bureau of Mines, the Ohio Chamber of Commerce and other like organizations are excellent Co-operative projects are carried on with many of these groups We could not do our job without their support

This is a conservation program The key to mineral conservation is a policy of intelligent use True conservation is making the most of what we have Such a policy is founded on the following principles

1 Avoid waste and needless destruction of our mineral resources
2 Gain full basic knowledge of our resources and their potentialities
3 Exploit low-grade reserves and find new resources through improved exploration and production methods
4 Increase recovery of minerals in processing through improved methods
5 Find uses for abundant latent mineral resources and widen the utilization of byproduct minerals

6 Adopt broad, forward-looking research programs to advance all phases of mineral technology
7 Promote a healthy mineral economy which will encourage the investment of risk capital vital to mineral production and which will insure the maximum life span to declining production.

We are dedicated to such a program by tradition, by past performance and by the new natural resources law You may rest assured that in the future, as it has in the past, your Survey will be making its contribution, through science, to a greater Ohio

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OHIO ACADEMY OF SCIENCE NEWS

The members of the Academy will be interested to know of the results of the effort to increase the membership At the Council meeting on April 27, 261 members were added to the organization, an all-time high for any single year and the total membership is at an all-time high of almost 1200 members This makes our Academy one of the largest state Academies and it is much larger than many of the national organizations to which most of us belong The membership by sections is as follows

A	Zoology	260
B	Plant Sciences	197
C	Geology	164
D	Medical Sciences	166
E	Psychology	55
F	Physics and Astronomy	50
G	Geography	49
H	Chemistry	109
I	Mathematics	27
J	Science Education	60
K	Anthropology and Sociology	36
	Libraries, Corporations and Institutions	20
	Total	1,193

Amendments to the constitution provided for two new classes of membership, Corporation and Institution A special committee has been at work securing such memberships and to date four Corporation and twelve Institution Memberships are in force Many of the members could assist in this project by a little missionary work in the organization, corporation or college and University, with which you are connected but you are asked to work closely with the special committee so that efforts will not be duplicated and so that no organization will feel it is being "high pressured" into taking out a membership Dr H H M Bowman, of the University of Toledo, is chairman of the committee Please contact him to offer your assistance

The present institution members are Baldwin-Wallace College, Bowling Green State University, Case Institute of Technology, Fenn College, Mary Manse College, Marietta College, Miami University, Ohio State University, Ohio University, Ohio Wesleyan University, University of Cincinnati and Wittenberg College

The Treasurer is making a special effort to collect all dues which are outstanding If you have not paid for 1950 please remit at once so you will not miss issues of the JOURNAL and so your name will not have to be removed from the membership roll Remember that the dues are now $3 00 per year as a result of an amendment passed at the annual meeting

PROGRAM RESPONSIBILITIES AND PROBLEMS CONCERNING WATER RESOURCES IN OHIO

R J BERNHAGEN
Principal Geologist Ohio Division of Water

Recently there has been much publicity regarding water shortage in a number of areas throughout the nation

Most prominent of these of course is the New York situation Other industrial areas such as Louisville Memphis Houston and Youngstown are faced with the same problem

These are disheartening affairs in a nation such as ours in which technical know how seems unlimited Our engineering and scientific achievements are excelled by no other country in the world yet we seem to be unable to accomplish a solution to the problems of our water resources

These recent water shortages tragic in a way have been beneficial in one respect to the nation as a whole The publicity has been helpful in awakening the nation to reconsider the status of one of its most valuable natural resources At no time in the history of our country have the people been so conscious of water and the problems related to it Agencies of the Federal government have been studying the problem for many years and most state governments have in recent years instituted programs of study to determine causes and to recommend remedial measures

In the State of Ohio an active program to study Ohio s water resources has been in effect since 1941 when the Ohio Water Supply Board was created by the General Assembly Later the organization became the Ohio Water Resources Board and today the work is carried on by the Division of Water in the Department of Natural Resources

PROGRAM OF OHIO DIVISION OF WATER

Briefly the duties of the Ohio Division of Water entail the collection study and interpretation of the available data related to the water resources of the State of Ohio In the formulation of the law creating this organization it was the intent of the legislators to create an agency that would collect the basic data regarding the status of our water resources analyze the data and make it available to the citizens of the State so that ultimately a sound water conservation program could be established

However before discussing a water conservation program it is necessary to define what is meant by water conservation Unlike other minerals water as it occurs in Ohio is replenished annually and cannot be saved or conserved by non use Conservation of water means obtaining the maximum beneficial use of water and protecting those resources from polluting or deleterious matter which render water unfit for use It is that concept on which the program of the Ohio Division of Water is based

The program of the Division divides itself into the following categories

1) Water resources inventory
2) Field investigations
3) Analysis of inventory and field data
4) Publications and reports of inventory and analysis
5) Regulation
6) Assistance to individuals industries and public agencies

First on the list is water resources inventory Mr C V Youngquist[1] Chief of the Division of Water, has stated "a fundamental conservation measure is a

TABLE I

ACTIVITIES OF THE OHIO DIVISION OF WATER

INVENTORY	INTERPRETATION	REGULATION	CONSTRUCTION
A Stream Flow 1) Gaging 2) Chemical quality 3) Siltation a) Suspended b) Deposits in reservoirs 4) Pollution	A Statistical Analysis 1) Flood frequency 2) Drought frequency B Flow Characteristics 1) Flood flow 2) Low flow 3) Relation to soil, geology and land use C Storage Requirements D Design of Bridges and Culverts E Chemical Quality 1) Treatment required 2) Deleterious factors 3) Pollutants	None Common Law of Riparian Rights	A Building of Dams Financed by Issuance of Revenue Bonds B Bridge Dam Law C Farm Ponds
B Ground Water 1) Gaging (Water table fluctuations) 2) Survey of pumpage 3) Pumping tests 4) Chemical quality 5) Geology of water 6) Processing of well logs	A Quantities Available (yield) B Source and Rates of Recharge C Pump Sizes and Rates of Pumping D Well Spacing E Chemical Quality 1) Treatment required 2) Deleterious factors 3) Pollutants F Extent and Thickness of Aquifers	A Filing of Well Logs by Drillers B Rules and Regulations to Prevent Contamination of Ground Water C Enforcement	None
C Climatic Factors 1) Rainfall 2) Temperature 3) Evaporation 4) Assemble in available form	A Rainfall Analysis 1) Frequency and magnitude of intense rains 2) Frequency and duration of drought 3) Trends B Temperature Analysis 1) Distribution 2) Trends C Evaporation		

continuing inventory of the supply of water available from streams and underground reservoirs and the chemical and physical properties of those supplies This

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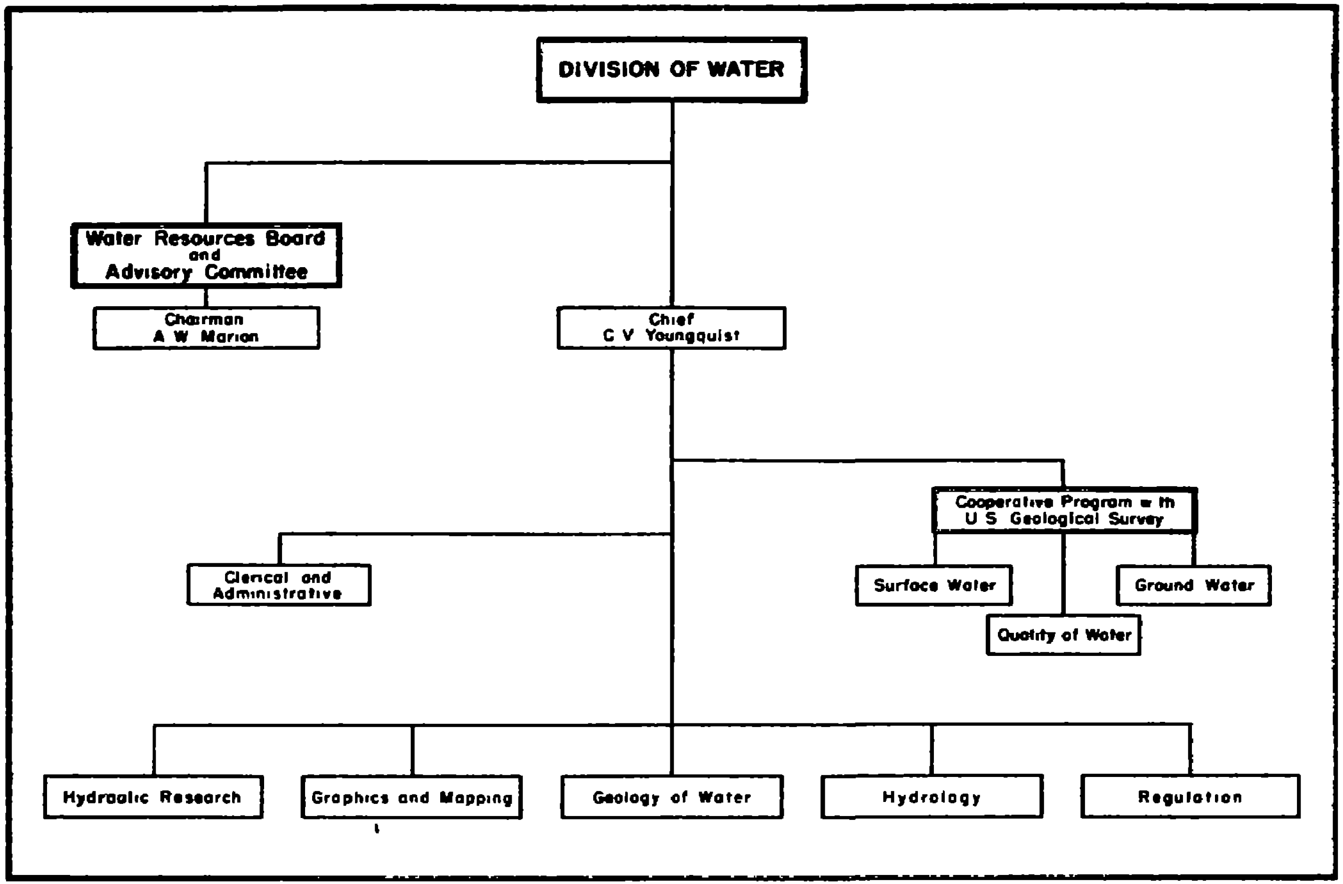
[1] C V Youngquist Annual Report of the Division of Water and Ohio Water Resources Board for the year 1949

TABLE II


DIVISION OF WATER
Water Resources Board and Advisory Committee
Chairman A W Marion
Chief C V Youngquist
Cooperative Program with U S Geological Survey
Clerical and Administrative
Surface Water
Ground Water
Quality of Water
Hydraulic Research
Graphics and Mapping
Geology of Water
Hydrology
Regulation

inventory is and must be carried on continually to prevent over-development or misuse of Ohio's most valuable resource " The water inventory requires measurement of water in all phases of its occurrence Principal determinations are precipitation, stream flow, ground-water fluctuations, evaporation and transpiration, soil moisture, and the chemical and physical quality of water

At the present time quantity of stream flow is measured at 188 gaging stations strategically located throughout the State Automatic recording gages are maintained on 111 observation wells which are drilled into a majority of the principal water bearing formations These records give a positive answer to such questions as "Is the water table falling?" During 1949, 262 chemical analyses were made of water from the streams and underground reservoirs A survey of ground water pumpage of the State indicates that over 500 million gallons are pumped from the ground each day A pumpage inventory will be conducted periodically to determine areas in which over development is occurring Approximately 30 pumping tests have been conducted at municipal and industrial well fields Such tests reveal the hydraulic properties of aquifers and are fundamental in the establishment of pumping rates and in the spacing of wells to obtain the most efficient well field development The Division receives and processes approximately 9,000 water well logs each year

The above group of activities is far from complete but it is presented to exemplify the type of work involved in a water resources inventory Many phases of the inventory are conducted co-operatively with the Surface Water Branch, Ground Water Branch and Quality of Water Branch of the U S Geological Survey For the sake of brevity the activities of the Division of Water are outlined on the chart in Table I and the organization chart is shown in Table II

Factors Involved in Water Problems

In view of the fact that considerable publicity has been given to current water shortages, both in Ohio and the nation, there has arisen in the minds of many people certain false concepts regarding the status of our water supplies, both present and future It may be advisable at this time to discuss the causes of water shortages and the possible remedial measures that may be taken, and from that discussion some of the problems of the Division of Water will become apparent

The causes of water shortages automatically fall into two categories—assumed causes and real causes

Assumed Causes

1) In the minds of many people it is believed that our climate is changing—that we are getting less and less rainfall every year This is far from true Examination of rainfall records from the U S Weather Bureau shows this is not the case

2) A second assumption is that the water tables throughout the country are dropping One popular writer has made the claim that ground-water levels in Ohio have dropped 50 feet in the last 25 years In some areas in Ohio, water levels have been rising in the past few years Ground-water levels are recorded every minute of the day by 111 automatic recording instruments installed on observation wells, and analysis of these records show that there is no continuous decline in ground-water levels Only one area has experienced critical lowering of water levels This area will be discussed later

3) It is believed that water shortages have been brought about by the removal of the forests Locally under favorable conditions it may have some influence but to say that the removal of our forests and the abuse of our farm lands has created water shortage universally has no basis in fact

Real Causes

There are two principal causes of water shortages—droughts and overdevelopment

The source of all water is the atmosphere Whether it is ground water or surface water, it originates from rainfall It is rainfall that keeps our streams flowing and it is rainfall that recharges the underground reservoirs In periods of deficient rainfall our surface water is diminished and our water tables are lowered In the centuries past, this country, as well as other countries, has witnessed periods of drought as well as periods of plentiful rainfall The magnitude, distribution and frequency are the factors which affect the amount of water available for human consumption In the design of water supply systems these variable factors must be taken into consideration

In the development and use of our water resources, we must recognize certain things

1) That water resources are limited—there is no such thing as an unlimited water supply This applies to both surface water and ground water There is no great difference between a surface-water reservoir and a ground-water reservoir—you can see one but not the other They both have definite physical limitations and they both behave according to certain established physical laws Reservoirs will yield just so much water In the case of a surface-water reservoir, the yield is determined by the design of the reservoir In the case of a ground-water reservoir the yield is determined by the physical make-up of the aquifer and its hydraulic properties

Most of the current shortages have arisen, not from natural causes, but because of overpumpage which has come about from the increased demands for water

2) We must recognize that as our population increases the demands for water will increase In the past ten years the consumption of water in this nation has about doubled In another ten years that demand may again double

Ground-water consumption in the nation is about 20 billion gallons daily Here in Ohio daily pumpage from the ground is about 500 million gallons With the expansion of industry, the growth of municipalities and the increase in demand for water for irrigation the above figures will continue to mount

A majority of the water shortage problems involve ground water, and therefore this discussion shall be confined to ground water Furthermore a consideration is given to the problem as it affects the State of Ohio rather than the nation

The following table lists those areas in Ohio where ground-water pumpage exceeds 10 million gallons per day

INDUSTRIAL AND MUNICIPAL GROUND WATER PUMPAGE

	Million gallons per day
Montgomery County	93 0
Stark County	06 0
Butler County	50 0
Hamilton County	45 0
Franklin County	30 0
Summit County	28 0
Ross County	27 0
Muskingum County	17 0
Richland County	13 0
Jefferson County	12 0

Of all the heavily pumped areas in Ohio only one is experiencing a critical shortage of water This is the Mill Creek Valley area of Hamilton County The ground-water requirements of the industries and municipalities in the Mill Creek Valley have exceeded for years the amount of water available in the underground reservoir The daily pumpage has averaged about 14 million gallons since 1930 The average rate of recharge over a long period is estimated to be 11 million gallons per day As a result ground-water levels have been lowered as much as 90 feet below the surface and will continue to decline so long as the pumpage is in excesss of the natural recharge of the aquifer The hydrograph of observation well No 265-5 in this area is shown on Fig 1 and a north-south longitudinal profile of

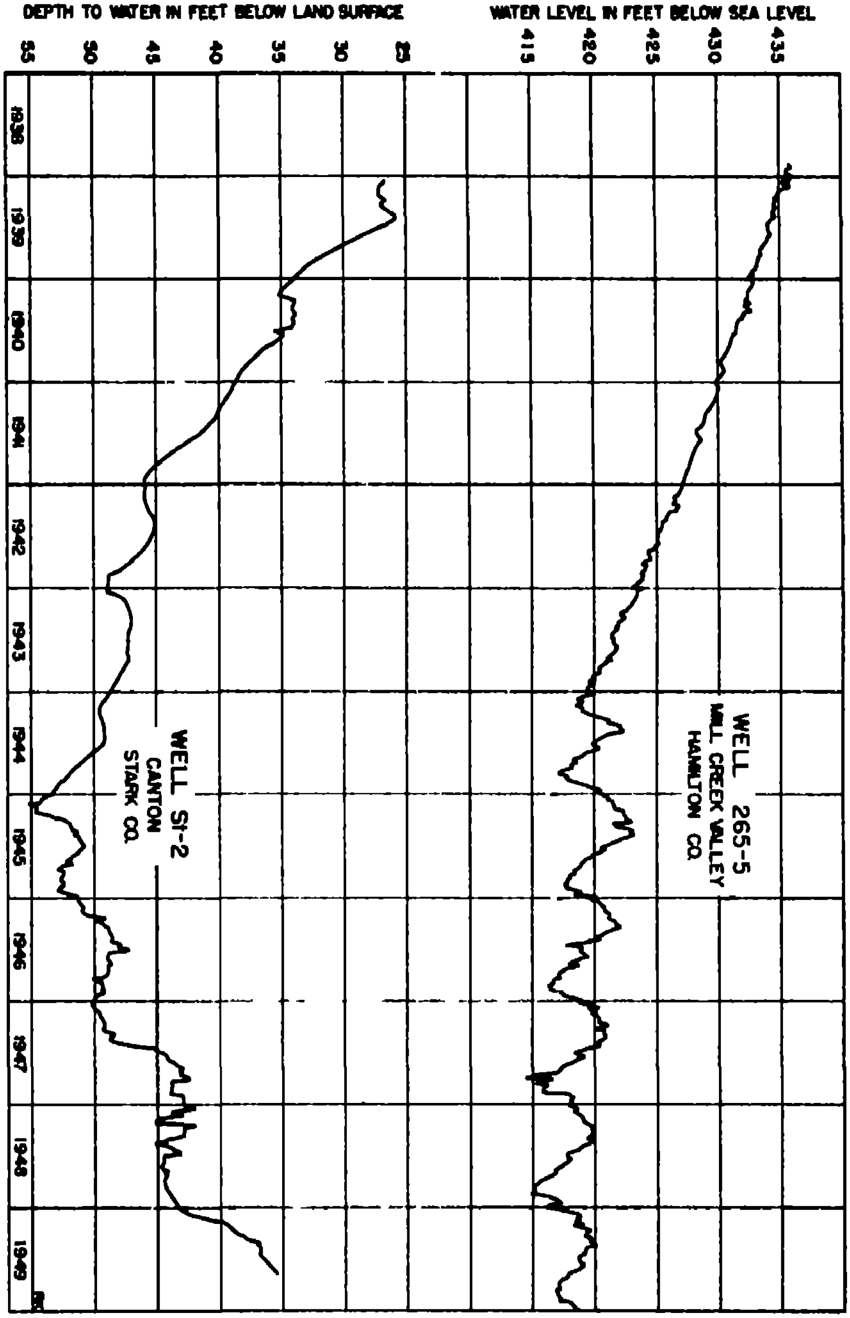


Fig. 1. Hydrographs of observation wells.

the piezometric surface is shown in Fig 2 Organized efforts of the industries in the valley have resulted in decreasing the pumpage and to some extent slowing down the rate of decline Conservation methods have been adopted and investigations are in progress to determine the feasibility of importing water from other ground-water areas within the county Previous to 1945 in the Canton area of Stark County serious declines in ground-water levels were occurring This is shown by the hydrograph of well ST-2 on Fig 1 Following the cessation of World War II water demands by war industries decreased and since that time the City of Canton has developed a new well field removed from the area of heavy pumpage As a result of the redistribution of pumpage, water levels have raised to a point higher than existed in 1940

Throughout Ohio there are a number of villages and small cities which are experiencing difficulty in keeping up with the increased demands of a growing community In some instances the geology of the area is such that additional large volumes of ground water are not available and it is advisable in such cases to change the source of supply from ground water to surface water In other instances it is possible to spread the pumpage over wider areas A common failing of many municipal well fields is the close spacing of wells, often 3 or 4 wells will be placed on an acre of land Furthermore it must be borne in mind that there are extensive areas in Ohio where subsurface conditions do not allow for the accumulation of large volumes of ground water In these areas attempts to develop municipal or industrial supplies should be discouraged and farm and domestic consumers should be informed as to the best type of water supply development to suit the prevailing condition

Regarding the solution of existing ground-water supplies certain procedures are self-evident

1) Redistribution of pumpage in some areas
2) Development of supplementary supplies from other sources
3) Use of surface water in winter and ground water in summer where temperature is an important factor
4) Artificial recharge—either by water spreading or by recharge wells This assumes additional water is available
5) In certain rural areas where the subsurface material is relatively impermeable additional low yielding wells are advisable and supplemented by farm ponds and cisterns

It must be borne in mind that ground-water problems are localized and that solutions must be based on careful studies of, the local geologic and hydrologic conditions The application of certain remedial measures may work in one area but fail in another This may be exemplified by contrasting the situations existing at Dayton and Greenville At Dayton the aquifer is recharged by the water spreading method It is effective because the gravel aquifer exists at the surface and continues downward to a considerable depth At Greenville about 40 feet of clay overlies a gravel aquifer Water spreading in this area would be ineffective

Thus far no mention has been made of reforestation as a means of solving water problems This feature has not been mentioned because of its questionable value It is important to recognize the effectiveness of forest cover in retarding runoff, reducing soil erosion and increasing soil moisture but as a universal panacea to the solution of water supply problems reforestation cannot be considered as a prime factor but only as a supplement to the overall local picture Only under ideal conditions of geology and topography will forest cover be beneficial in recharging ground water Recharge, either by natural processes or man-made devices, presupposes one condition, that a porous and permeable medium is present to conduct the water from the surface to the ground water reservoir Diller has shown that in level country the effect of forests in flood control and underground storage is of

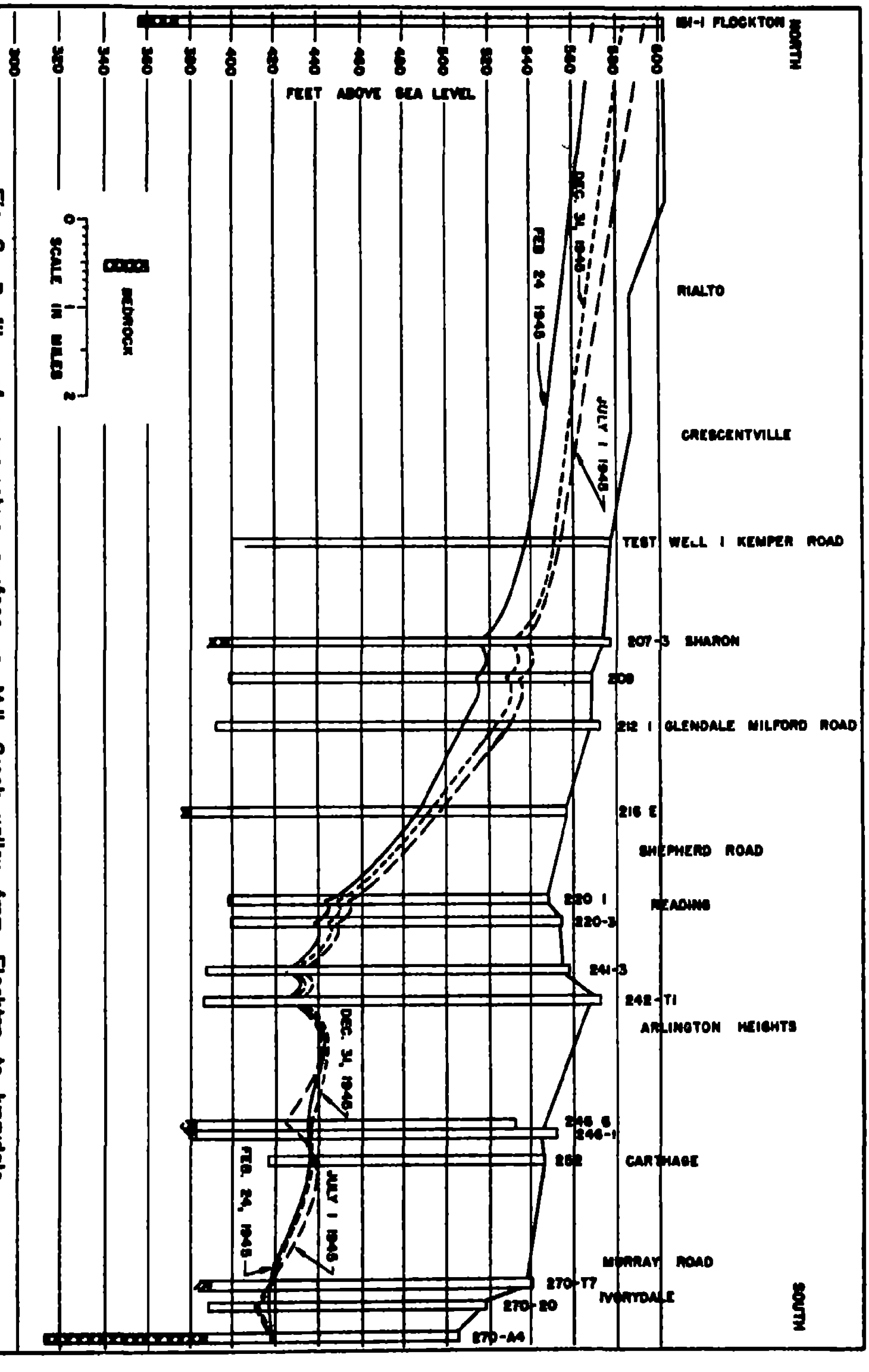


Fig 2 Profiles of piezometric surface in Mill Creek valley from Flockton to Ivorydale, Butler and Hamilton Counties, Ohio, 1945.

little consequence In fact, it has beeen demonstrated that in level country forests tend to lower the water table and reduce soil moisture to a greater degree than other forms of vegetation Diller[2] clearly expresses the attitude of foresters on this subject in the following quotation

"It is apparent that the water shortages in many parts of Ohio during recent years cannot be attributed solely to the lack of forest cover Very few foresters claim that forests will maintain a high water level when prolonged dry periods occur and where there is heavy pumpage for industrial uses Furthermore, most foresters concede that floods which are produced by exceptional meteorological conditions cannot be prevented by forests But without the mitigating influence of forests, floods are more frequent, more severe and more destructive It is important that we recognize the beneficial effects which forests have on water relations but that we must refrain from exaggeration Well managed forests can justify themselves through wood production and erosion control without the necessity of making broad claims about their effect on water tables and floods"

In conclusion it may be said that there is no present danger of depleting the ground-water supplies in Ohio except locally Water shortages are not a recent development Temporary and localized shortages have existed since our country was settled But in the early days there was some excuse for failures Knowledge of geology, hydrology and hydraulics was in its infancy and errors in judgment were common In the not too distant past lack of knowledge or poor judgment has resulted in some of the shortages which exist today

In order to accomplish a sound program of water conservation in the State of Ohio certain long term objectives are imperative The following objectives have been set forth by Mr C V Youngquist[3], Chief, Ohio Division of Water in his report to the Governor and the General Assembly of the State of Ohio

LONG TERM OBJECTIVES

1) Action programs on the wise utilization of water must be based on adequate facts on quantity and quality of available water These facts must be collected now for the expanding use and development of water in Ohio which is certain to occur

2) Most water problems are unique to an area, and each requires an individual plan No ready made plan can be applied to a region

3) Any successful plan for wiser water use will require a combination of methods of engineering, hydrology, geology soil conservation and reforestation

4) Any water resources development should be integrated with an overall basin plan with proper consideration of regional and functional needs in order to insure the best overall use

5) The river basins of the state should be examined, investigated, and classified as to potential use with sufficient flexibility to permit alterations as conditions require Such plans will require records of stream regimen, ground-water fluctuations, quality of water determinations, and other basic data

6) Underground water must be preserved against over development and reckless drilling operations Experience indicates that additional regulatory authority may be required to obtain the desired results

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[2] Oliver D Diller, Forests and Water, ' OSU Engr Exp Sta News, April 1946

[3] C V Youngquist Annual Report of the Division of Water for the year 1949

CONCERNING RATES OF UTILIZATION OF SOME OF THE FOREST RESOURCES, AND THEIR ECONOMIC IMPORTANCE, IN CANADA[1]

FRED H GLENNY[2]

The economic life of a new or pioneer country is at first entirely dependent upon the raw natural resources of the country Later on as the original supply dwindles, is depleted or exhausted, the people turn to manufacturing, farming, fishing, shipping, and similar pursuits which do not require further gross depletion of the available resources, but rely more upon efficient and more nearly complete utilization of these raw resources

Canada is a fairly young country by most standards, but it is a land of such great area and such low population that the development of an independent and natural internal economy has resulted in the expenditure of a vast amount of her best resources, both timber and mineral, in an effort to become more self-sufficient

Fur, fish, and forests have served as the basic commodities for trade for the past 200 or more years Serious exploitation of the timber resources has taken place during the past 100 years, with the resulting depletion of available first grade timber

During the past 40 to 50 years, however, there has been a strong effort made to establish a workable program to conserve the chief natural resources, and to replenish these wherever possible

In some areas which were studied recently, a program of reforestation and improvement in land use has been suggested and first steps appear to have been taken to initiate an effective cutting and forest management program For the most part, however, the large lumber and pulpwood operators and associated industries have "managed" the areas which they hold under lease or otherwise control In scattered areas, however, where the cutting is under individual lease or contract, little effort is made to do any selective cutting with the result that any tree of six inches diameter may be cut and used for pulpwood or stovewood This is particularly true of cut-over areas of western Quebec

Some statistics may serve to point out the value of the wood and timber resources of Canada and show some of the value of both the primary and secondary forest products to the United States

LAND AND WATER AREAS				
Area of Canada (exclusive of Labrador and Newfoundland)				
Land Area	3 462 103	square miles		
Water Area	228 307	" "		
Total Area	3 690,410	" "		
Area of Labrador	110 000	" "	(approximate)	
Area of Newfoundland	42 734	" "	"	
Total Area at present	3 843,144	" "		
Area of United States and Dependencies	3,738 395	" "		
Area of United States	3,022 387	" "		
Area of Alaska	586 400	" "		
Area of Europe	3,776,700	" "		
POPULATION				
Canada				11,500 655
Labrador				4,716
Newfoundland				313 000
Total				11,824 371
United States (1940)				131,669,275
Alaska (1940)				72,524
United States 1950 estimate—between 149 and 150 millions				

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[1] Based on a paper, ' Rape of the Bush, presented before the Ohio Academy of Science, Capital University, April 28 1950

[2] Visiting Lecturer in Biology The College of Wooster, 1949-1950

Distribution of Canadian population	
Urban centers	5 572 058
Rural Districts	4 804 728
Other	1 129 869 (approximate)

Agriculture ranks first in primary and secondary industries in Canada with a value in 1947 of $1 579 604 000 The agricultural lands in 9 provinces totals approximately 1 276 109 440 acres The potential agricultural land is estimated at 352 157 190 acres About 60 million acres are in field crops while 8 250 000 acres are in pasture

Forestry and forest products rank second in Canadian industries with a value in 1947 of $953 918 800 Since then however there has been further increases in utilization and as a result increases in the value of the primary and secondary products By 1950 37% of the land area of Canada and 58% of the land area of the nine provinces are occupied by forests

	1945	*1949*
Productive Forest	38 3%	32 7%
Softwood	23 3%	17 7%
Mixedwood	10 5%	10 5%
Hardwood	4 5%	4 5%
Non productive Forest	20 0	24 8%
Non forested Land	41 7%	42 5%

	1947	*1949*
Productive Forested Lands	813 110 square miles	701 232 square miles
Non productive Forested Lands	477 850	573 608
Non forested Lands	2 171 143 " "	2 187 263
Total Land Area of Canada –	3 462 103 " "	

Net value of production of the primary and secondary industries of Canada for 1947	$7 765 415 275
Agriculture	1 579 604 000
Forestry	953 918 800
Mining	552 309 949
Electrical Power	233 860 860
Fisheries	110 088 471
Trapping	16 842 966

Employment in the logging industry as of 1 December 1949 for establishments of 15 or more men reveals that for Canada 73 952 men were employed Of this total 17 992 were employed in Ontario while 33 751 worked at logging in Quebec Thus more than two thirds of the numbers employed in logging worked in two provinces alone

Based on information available prior to 1948 58 3% of the provincial lands were forested Of this 20% was non productive forested land and 38 3% produced the wood and timber for the trade Of the total land area of Canada including the Northwest Territories and Yukon but excluding both Labrador and Newfoundland only 37 3% of the land area is forested and 23 5% is productive forest land while 13 8% is in non productive forests Exclusive of Labrador and Newfoundland Canada has 62 7% of the land area unforested while only 41 7% of the provincial land area is *non forested*

Total Merchantable Forest Types	*1945*	*1949*
CANADA	392 085 square miles	294 180 square miles
Percentage of Land Area	11 3%	8 5%
9 PROVINCES	384 085 "	286 180 "
Percentage of Land Area	19 2%	14 3%
Quebec	229 840 " "	131 985 " "
Ontario	66 900 "	66 900 "
British Columbia	35 400 "	35 400 " "

Total Young Growth	*1945*	*1949*
Canada	421,025 square miles	407 052 square miles
Percentage of Land Area	12 2%	11 7%
9 **Provinces**	382,025 " "	368 052 " "
Percentage of Land Area	19 1%	18 4%
Quebec	72,860 " "	58 680 " "
Ontario	106 900 " "	106,900 " "
British Columbia	50,490 " "	50,492 " "
Non-productive Forested Land		
Canada	477 850 square miles	573 608 square miles
Percentage of Land Area	13 8%	16 6%
9 **Provinces**	401 850 " "	497 608 " "
Percentage of Land Area	20 0%	24 8%
Quebec	69 590 " "	165 394 " "
Ontario	63,400 " "	63,400 " "
British Columbia	128 500 " "	128 564 " "
Non forested Land		
Canada	2,171 143 square miles	2 187 263 square miles
Percentage of Land Area	62 7%	63 2%
9 **Provinces**	835,359 " "	851 479 " "
Percentage of Land Area	41 7%	42 5%
Quebec	151 570 " "	167 801 " "
Ontario	126 082 " "	126 082 " "
British Columbia	144 829 " "	144 823 " "

In 1947, primary forest production rose to a value of $519,804,128, representing the utilization of 3,091,086 units (1000 cubic feet) of merchantable timber Of this amount, Quebec produced 1,114,018 units, British Columbia yielded 666,142 units, and Ontario produced 613,919 units During the same period, a total of 5,877,901 units (1000 feet board measure) of lumber were produced in Canada, with a value of $322,048,356 Of this, British Columbia produced 2 707,052 units with a value of $164,199,747, Quebec ranked second with a total of 1,227,055 units and a value of $63,258,288, and Ontario stood third in production with some 733,129 units having a value of $41,526,059 Ontario produced 2,130,838 rough cords of fuelwood, with a value of $13,473,594, while Quebec produced 3,897,013 rough cords, with a value of $17,678,762

Of accessible productive forested land, Ontario has 52,500 square miles in merchantable timber and 95,100 square miles in young growth—a total of 147,600 square miles, while Quebec has 95,087 square miles of merchantable timber and 50,305 square miles of young growth, with a total area of 145,392 square miles of timber lands

In 1948, wood pulp production for Canada reached a level of 7,675,079 tons, with a value of $485,966,164 At the same time, paper production was in the vicinity of 6,063,646 tons, with a value of $582,346,842 For the same period, the apparent production of pulpwood in rough cords for Ontario was 3,390,284 units an increase of 257,666 rough cords over the 1947 level of production, while Quebec produced 6,321,800 units, an increase of 374,837 rough cords over the 1947 level The attending value of production of pulpwood for 1948 Ontario—$76,830,250, an increase of $14,648,708 over 1947, Quebec—$148,384,145, an increase of $19,645,567 over 1947 Exports of primary forest products, in 1948, amounted to $66,186,095, an increase of more than $10,000,000 over the 1947 level

CANADIAN LUMBER EXPORTS
(Units of 1000 feet board measure)

	1947	*1948*
All countries	2,735,027	2,467,740
United Kingdom	1,121,244	565 653
United States	1,065,216	1,625,223

There was a decrease in the total exports, in one year, of 267,287 units The United Kingdom reduced imports from Canada by 555,591 units, while the United States increased imports from Canada by 550,007 units

In 1948, total woodpulp exports amounted to 1,797,998 tons, with a value of $211,564,384 This represents an increased production of 99,286 tons over the 1947 level, and an increased value of $33,761,772 Of this, 170,596 tons were exported to Great Britain, an increase of 33,620 tons over 1947 exports, and 1,590,674 tons were exported to the United States, an increase of 91,373 tons over the 1947 business level

Exports of paper in 1948 had a total value of $416,681,607, representing an increase of $43,611,269 over the previous year Of this, 4,328,083 tons of newsprint had a value of $383,122,743 This represents an increased production-export of 107,304 tons in one year, with an increase of $40,829,585 for the same period Of the total exports of paper, for 1948, the United Kingdom used 101,050 tons at $10,603,445, of which 60,690 tons were newsprint costing $5,319,660, the United States imported 4,067,709 tons of paper at a cost of $354,176,645, and 3,917,366 tons of this paper, with a value of $340,334,045, was in the form of newsprint

These few facts and figures may serve to give an idea of the value of the forest products of Canada, and to a somewhat less extent, the importance and value of wood-products which are imported by the United States from our closest neighbor, Canada

During the past few years there has been a phenomenal increase in the utilization of Canadian forest products Comparisons can be made on utilization during 10 years of depression (1930–1939), six years of war (1940–1945), and two to three years of post-war prosperity In the following tables, only averages (for a one year period) are used

PRIMARY FOREST PRODUCTION

(Logs and Bolts, Pulpwood, Fuelwood, etc)

1930–1930	$174 806 145
1940–1945	257 768,977
1946–1947	466,536,721

PRIMARY FOREST PRODUCTION

(In 1000 s of cubic feet of Merchantable Timber)

Period	*Canada*	*Ontario*	*Quebec*
1930–1939	2,011 323	440,631	685 846
1940–1945	2,586,527	496,430	946 174
1946–1947	2,951,902	589,210	1 092 159

LUMBER PRODUCTION

(In 1000's of feet Board Measure)

Period	*Canada*	*Ontario*	*Quebec*
1930–1939	3,096,941	411 635	501 645
1940–1945	4,649,208	581,487	953 600
1946–1947	5,480,590	703 285	1,194,331

WOOD PULP PRODUCTION

(Total for Canada)

1930–1939	$ 87,520,735	3,739,583 Tons
1940–1945	192 337,261	5,460,475 "
1946–1948	392,381,208	7,181,389 "

PAPER PRODUCTION

(Total for Canada)

1930–1939	$141 880 065	3,160 054 Tons
1940–1945	244,999 424	4,241,936 "
1946–1948	495,468,170	5,728,615 "

The annual value of Primary Forest Products for the post-war period is more than 250% greater than the average value for the ten year period of the depression While the production of woodpulp is just less than double the depression production level, the value for the output has more than doubled per unit product

From the above information, it might well be assumed that, at the present rate of forest products utilization, Canada may soon be faced with severe shortages in timber and pulpwood resources While this would be true, in the absence of proper management practices, it is safe to say that many of the leaders in Canada are alert to the importance of the problem, and are taking some steps to avert excessive and gross depletion of this basic material which plays so important a part in the general Canadian economy In the event of another war, at an early date, further depletion of the forested areas will undoubtedly occur What ultimate effect this would have on the productivity of the forested areas cannot be adequately assayed at the present time Needless to say, with the present rapid growth and expansion in the population and in industry in the United States, it is necessary to look to Canada to obtain many of the materials and products which are considered essential to our own way of life

Inexcusable waste of natural resources has followed with man's exploitation of new lands, but continued wastage ultimately results in serious want One of the largest causes of losses in forest resources results from fire The annual forest fire losses in Canada, for the period 1939–1948 are reported to be as follows

MERCHANTABLE TIMBER	439 389 acres
YOUNG GROWTH	402,433 acres

FIRES BY CAUSES	NUMBER	PERCENT
Smokers	1 040	10 8
Campfires	852	16 1
Settlers	658	12 5
Railways	501	9 5
Incendiary	187	3 5
Other man made causes	684	12 9
Unknown	378	7 2
Lightning	970	18 5

The total estimated losses, including fire-fighting costs each year amounts to $4,888,221

ACKNOWLEDGMENTS

The writer wishes to express his gratitude to the Honourable H L Keenleyside, Deputy Minister of Resources and Development, Department of Mines and Resources, Ottawa, and to his assistants for the generous assistance given him in obtaining materials for this paper

REFERENCE

Statistical Record of the Forests and Forest Industries of Canada, 3rd Edition Ottawa 1948
Amendment List (to the above)—1949

OBSERVATIONS ON THE MICHIGAN FLORA, III[1] THE FLORA OF GREEN ISLAND (MACKINAC COUNTY)[2]

EDWARD G VOSS
Mackinaw City Michigan

Green Island is a heavily vegetated sand and gravel bar rising from the Straits of Mackinac about 400–500 yards from Pt La Barbe, the nearest mainland (Mackinac County, Michigan) The island is approximately 600 meters long and varies from 30 to somewhat more than 80 meters in width A curved arm to the northeastward forms a bay facing to the west (See map, Fig 1)

The island may be seen on the charts covering the Straits of Mackinac prepared by the Survey of the Northern and Northwestern Lakes and on the advance sheet for the south half, St Ignace-Moran Quadrangle, State of Michigan, published by the U S Geological Survey The outline of the island on the latter map has been altered slightly in the preparation of Fig 1 The "Official Map of Cheboygan County, Michigan" shows the island and names it, but gives no indication of its true shape The detailed maps of Mackinac County distributed by the Michigan State Highway Department and the Conservation Department do not show Green Island

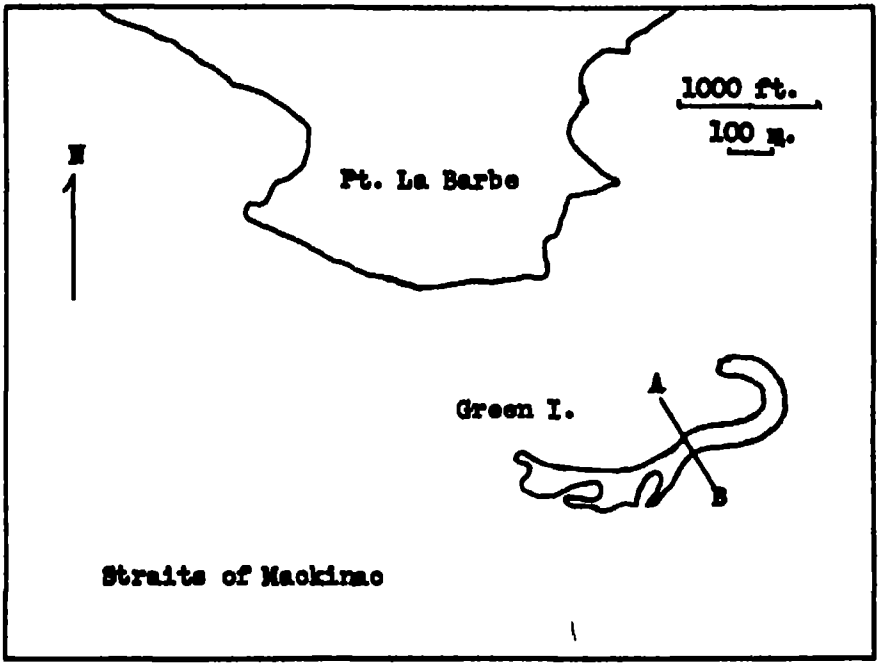

FIG 1 Map showing Green Island and nearest mainland

The relative size of the island varies greatly as the level of the Straits of Mackinac goes up and down in the annual fluctuations of the Great Lakes This situation accounts for the varied shapes given the island on the few maps which do show it It is actually a higher part of a large crescent-shaped shoal off Pt La Barbe Especially in low water years, other small islands occur on this shoal, but none approach Green Island in size

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[1] Cf "Literature Cited" for I and II

[2] Contribution from the Biological Station of the University of Michigan Presented at the Botany Section Michigan Academy of Science Arts and Letters at Ann Arbor March 24, 1950

Collecting trips to Green Island were made on June 30, 1947, August 20, 1948, June 4, 1949, June 16, 1949, and August 4, 1949, so a fair seasonal picture was obtained On August 4, 1949, some effort was made to note ecological groupings, and the profile appearing in Fig 2 was prepared

Gulls and terns use the island extensively as a nesting site, other birds are frequently seen on it, and a few song birds nest there Some seeds may have been brought by birds, but the proximity to the mainland suggests wind and waves as the principal sources of plants Local residents report deer swimming to the island, and fresh tracks were seen on August 4, 1949

Human visitations are frequent, with the assorted purposes of bird photography, bird banding, hunting, fishing, and picnicking Until several years ago local Indians visited the island regularly to obtain some plant, the identity of which is not known

Algae, lichens, fleshy fungi, and mosses occur on the island, but this report and list deal only with the vascular flora

There is not room on Green Island for proper development of many ecological associations, although as the profile in Fig 2 shows, there is a clear zonation of vegetation Line A-B on the map (Fig 1) crosses the island where the profile was made The letters A-M on the profile indicate rather well-marked zones as follows

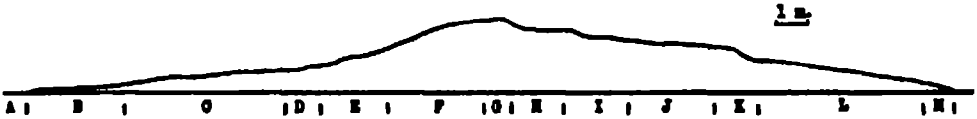

FIG 2 Profile of Green Island, with vegetation zones indicated (see text for description) The southeast end of the profile is at the left northwest at the right Horizontal and vertical scales are the same

A Straits of Mackinac (rocky bottom)
B Shore practically all rocks (about 1 dm in diam) Occasional plants are invading from the center of the island, with *Polygonum lapathifolium, P ramosissimum*, and *Potentilla anserina* the most abundant This and the next zone would be submerged in high water years
C Rocks with some sand Vegetation predominantly composed of *Polygonum lapathifolium* and *P ramosissimum*, with such plants as the following mixed in *Artemisia caudata, Lycopus americanus, Potentilla anserina*, and *Verbascum thapsus*
D Practically bare sand with a few rocks, beach of average high water years A few invading runners of *Potentilla anserina* are the only vegetation
E Sand, with pure growth of *Potentilla anserina*
F Much bare sand showing Plants almost entirely *Asclepias syriaca* and *Elymus canadensis*
G Largely *Tanacetum huronense* growing in sand and somewhat shaded by *Cornus stolonifera*
H At the height of the island, a thicket of *Cornus stolonifera*, shading *Poa compressa*
I Sandy soil, with *Elymus canadensis, Poa compressa, Potentilla anserina*, and small *Cornus stolonifera* and *Populus balsamifera* most abundantly represented
J Another mixed zone, with a dense growth of *Elymus canadensis, Juncus balticus* var *littoralis, Lycopus americanus, Potentilla anserina*, and *Solidago altissima*

K A very characteristic zone fringing the edge of normal wave action in high water years *Aster junceus*, *Solidago altissima*, and *S graminifolia* are the most conspicuous, with *Carex hystricina*, *Juncus balticus* var *littoralis*, *Lobelia kalmii*, *Potentilla anserina*, and invaders from other zones

L Broad rocky shore, with a great variety of plants Among those observed were *Brassica kaber* var *pinnatifida*, *Carex viridula*, *Cornus stolonifera* seedlings, *Epilobium glandulosum* var *adenocaulon*, *Eupatorium perfoliatum*, *Impatiens capensis*, *Lobelia kalmii*, *Lycopus americanus*, *Medicago lupulina*, *Oenothera* sp , *Panicum capillare* as well as other invading grasses, *Polygonum convolvulus*, *P lapathifolium*, *P ramosissimum*, *Potentilla anserina*, *P monspeliensis*, *Satureja glabella* var *angustifolia*, *Trifolium hybridum*, *T pratense*, and *Verbascum thapsus* This list could be extended considerably by including species more than a meter or two from the line along which the profile was taken

M Bare rocks, washed by waves in 1949

It must be remembered that this profile represents only one typical cross section of the island, and those plants apparent in early August Near the tip of the northeastern arm, aquatic associations would have been evident, with *Scirpus acutus* in the water along with *Sagittaria latifolia* f *gracilis*, on a muddy shore *S latifolia*, *Potamogeton gramineus* var *typicus*, and *Scirpus americanus*, then a zone of *Polygonum lapathifolium* On the comparatively flat top of this arm *Fragaria virginiana* is abundant, with various shrubs and plants characteristic of the Great Lakes beaches Thicket-formers besides *Cornus stolonifera* in different parts of the island are *Populus tremuloides*, *Betula papyrifera*, and *Thuja occidentalis*

On August 20, 1948, a few minutes were spent on a smaller (unnamed) island a short distance west of Green Island and a part of the same shoal To general appearances the vegetation was much the same, although not so varied On this smaller island the largest plant was a fairly good-sized *Fraxinus pennsylvanica* var *lanceolata*—much larger than those on Green Island *Cornus stolonifera* formed tall and very dense thickets on the small island, and among the herbaceous species *Asclepias syriaca*, *Epilobium glandulosum* var *adenocaulon*, *Impatiens capensis*, and *Potentilla anserina* were the most striking Low spots along the south shore had extensive growth of *Typha latifolia* and *Phragmites communis* var *berlandieri*

The following plants occurring on Green Island appear not to have been reported from elsewhere in Mackinac County (Cf "Literature Cited" for sources of previous references) Those marked with an asterisk have been mentioned in a previous paper (Voss, 1949)

Bidens frondosa
Eleocharis acicularis
Eleocharis elliptica
Equisetum variegatum
**Eupatorium perfoliatum*
Phragmites communis var *berlandieri*
**Polygonum lapathifolium*
Potamogeton filiformis
Prunus serotina
**Salix interior*
Salix nigra
**Satureja acinos*
**Scutellaria epilobiifolia*

I am indebted to Dr Rogers McVaugh for assistance in the determination of numerous specimens and criticism of the manuscript, and to Dr Frank C Gates for many helpful suggestions Special thanks are also due Dr C R Ball for examining most of the *Salix* material and Dr F J Hermann for reviewing all the species of *Carex*

SUMMARY

1 Green Island, approximately 600 by 45 meters, lies in the Straits of Mackinac (Mackinac County, Michigan) within half a mile of Pt La Barbe, the nearest mainland

2 Five collecting trips to the island produced a list of the vascular flora numbering 138 species and varieties 13 of which do not appear to have been reported

from the mainland or from Mackinac Island (although they undoubtedly occur there)

3 Birds may have brought some seeds to the island, but human activities, wind, and water would account for most of the plants

4 There is in most places a distinct zonation of vegetation depending largely on high and low water levels in the Straits, but well-developed plant associations are not marked *Potentilla anserina* is the most abundant and widely distributed herb

ANNOTATED LIST OF THE VASCULAR FLORA OF GREEN ISLAND

The nomenclature of the list follows primarily the *Flora of Kalamazoo County, Michigan*,[3] supplemented as necessary by the *Flora of Indiana*[4] Species listed in neither of these volumes are named as in Gray's *Manual*[5] The only exceptions to this system are indicated by reference either to literature or to the specialist who named the material

Equisetaceae

1 *Equisetum variegatum* Schleich
One carpet of several square meters

Pinaceae

2 *Juniperus communis* L var *depressa* Pursh
3 *Juniperus horizontalis* Moench
4 *Larix laricina* (Du Roi) Koch
Scarce but one of the taller trees on the island
5 *Picea glauca* (Moench) Voss[6]
Several taller trees toward the west end of the island and one small one at the east end
6 *Thuja occidentalis* L
Small trees frequent forming conspicuous thickets in many places at the center of the island

Typhaceae

7 *Typha latifolia* L
Not common

Potamogetonaceae

8 *Potamogeton filiformis* Pers
In a pond at the southwestern edge of the island
9 *Potamogeton gramineus* L var *typicus* Ogden
On the edges of the pond at the southwestern edge and also on muddy shores in the bay formed by the northeastern arm of the island
10 *Potamogeton gramineus* L var *myriophyllus* Robbins
In the pond at the southwestern edge of the island

Alismaceae

11 *Sagittaria latifolia* Willd
At the pond at the southwestern edge and on muddy shores in the northeastern bay Form *gracilis* (Pursh) Rob occurs in shallow water at the latter location

Gramineae (Poaceae)

12 *Agropyron dasystachyum* (Hook) Scribn
In dryer spots, not common
13 *Agrostis gigantea* Roth (*A alba*)
14 *Agrostis scabra* Willd
15 *Elymus canadensis* L.
One of the commonest grasses on the island

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[3] Clarence R and Florence N Hanes Schoolcraft, Michigan, 1947

[4] Charles C Deam Indianapolis, 1940

[5] Seventh edition by Robinson & Fernald 1908

[6] Cf *Rhodora*, 17 59 (1915)

16 *Hordeum jubatum* L
17 *Panicum capillare* L
On rocky beaches scarce
18 *Phleum pratense* L
19 *Phragmites communis* Trin var *berlandieri* (Fourn) Fern
Not common
20 *Poa compressa* L
Common in dryer places
21 *Poa pratensis* L
22 *Sphenopholis intermedia* (Rydb) Rydb
Around the pool at the southwestern edge
23 *Phalaris arundinacea* L

Cyperaceae

24 *Carex garberi* Fern
Common
25 *Carex hystricina* Muhl
Common
26 *Carex stipata* Muhl
Scarce
27 *Carex substricta* (Kukenth) Mack
Very dense in some places along the shore
28 *Carex viridula* Michx
Common
29 *Carex vulpinoidea* Michx var *pycnocephala* Hermann
30 *Eleocharis acicularis* R & S
Forms small tufts on some of the sandy shores
31 *Eleocharis elliptica* Kunth
32 *Eleocharis palustris* (L) R & S
33 *Scirpus acutus* Muhl
Abundant in the pool at the southwestern edge and along the edge of the bay formed by the northeastern arm
34 *Scirpus americanus* Pers

Juncaceae

35 *Juncus alpinus* Vill var *rariflorus* Hartm
Common
36 *Juncus balticus* Willd var *littoralis* Engelm
Abundant
37 *Juncus nodosus* L
38 *Juncus tenuis* Willd var *dudleyi* (Wieg) Hermann
Scarce

Liliaceae

39 *Smilacina stellata* (L) Desf
One small patch
40 *Zigadenus glaucus* Nutt
Common in dry sand

Iridaceae

41 *Sisyrinchium montanum* Greene[7] (*S angustifolium*)
42 *Iris versicolor* L
Characters of both flowers and seeds place one clump of plants as this species
43 *Iris virginica* L var *shrevei* (Small) Anderson
Not common

Salicaceae

44 *Populus balsamifera* L
Rather common

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[7] Cf *Rhodora* 48 158 (1946)

45 *Populus tremuloides* Michx
Small trees are common and conspicuous
46 *Salix bebbiana* Sarg
47 *Salix bebbiana* × *candida*
Determined by C R Ball
48 *Salix cordata* Michx [8]
49 *Salix glaucophylloides* Fern. var *brevifolia* (Bebb) Ball (ined)
Named by C R. Ball
50 *Salix interior* Rowlee
Very common, forming dense thickets of shoots
51 *Salix lucida* Muhl
52 *Salix nigra* Marsh
Abnormal growth, and possibly a hybrid Determined by C R Ball

Betulaceae

53 *Betula papyrifera* Marsh
Several young trees

Urticaceae

54 *Ulmus americana* L
One small tree.

Santalaceae

55 *Comandra richardsiana* Fern
Not widespread, but rather common at the extreme eastern end of the island The plants have deep rootstocks

Polygonaceae

56 *Rumex crispus* L
57 *Polygonum ramosissimum* Michx.
In 1948, noticed only on a few sandy spots on the shore, in 1949 abundant on rocky shores as well
58 *Polygonum convolvulus* L
59 *Polygonum lapathifolium* L
Very common

Chenopodiaceae

60 *Chenopodium album* L
Found only near the water s edge in 1949, and apparently a new introduction to the island

Caryophyllaceae

61 *Arenaria serpyllifolia* L
62 *Lychnis alba* Mill

Ranunculaceae

63 *Anemone cylindrica* Gray
Scarce
64 *Anemone multifida* Poir
Common
65 *Ranunculus acris* L

Cruciferae (Brassicaceae)

66 *Barbarea vulgaris* R Br
67 *Brassica kaber* (DC) Wheeler var *pinnatifida* (Stokes) Wheeler
68 *Cakile edentula* (Bigel) Hook
69 *Capsella bursa-pastoris* (L) Medic
70 *Erucastrum gallicum* (Willd) O E S
Rather common along the shores A re-examination of material indicates that this is the species previously reported for the county (Voss, 1948) as *Diplotaxis muralis* (L) Dc from the St Ignace Causeway

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[8] *S cordata* Michx (not Muhl) replaces *S syrticola* Fern and *S adenophylla* Hook , according to C R Ball

71. *Erysimum cheiranthoides* L.

Apparently a new introduction in 1949; a very few plants at the water's edge.

72. *Rorippa islandica* (Oeder) Borbas var. *fernaldiana* Butters & Abbe.[9]

Crassulaceae

73. *Sedum acre* L.

Several patches.

Grossulariaceae

74. *Grossularia cynosbati* (L.) Mill.

Rather common.

Rosaceae

75. *Amelanchier arborea* (Mich. f.) Fern.

Two clumps are probably this species.

76. *Fragaria virginiana* Duchesne.

Common throughout.

77. *Geum* sp.

One large incomplete plant.

78. *Malus pumila* Mill.

A few trees.

79. *Physocarpus opulifolius* (L.) Maxim.

80. *Potentilla anserina* L.

Abundant and occurring in all situations except the wettest.

81. *Potentilla monspeliensis* L.

Common.

82. *Potentilla fruticosa* L.

83. *Prunus pumila* L.

Common.

84. *Prunus serotina* Ehrh.

Scarce.

85. *Prunus virginiana* L.

Scarce.

86. *Rosa blanda* Ait.

A few small unarmed shrubs may be this species.

87. *Rubus strigosus* Michx.

Forming thickets in some places.

Leguminosae (Fabaceae)

88. *Lathyrus japonicus* Willd. var. *glaber* (Ser.) Fern.

Common throughout.

89. *Medicago lupulina* L.

Not common.

90. *Trifolium hybridum* L.

91. *Trifolium pratense* L.

92. *Trifolium procumbens* L.

93. *Trifolium repens* L.

Anacardiaceae

94. *Rhus radicans* L.

In only a few places.

Balsaminaceae

95. *Impatiens capensis* Meerb.[10] (*I. biflora*)

Common in wet situations.

Hypericaceae

96. *Hypericum perforatum* L.

Not common.

---

[9] Cf. *Rhodora* 50: 100 (1948).

[10] Cf. *Rhodora* 50: 205 (1948).

Eleagnaceae

97 *Shepherdia canadensis* (L) Nutt
Scarce

Onagraceae

98 *Epilobium glandulosum* Lehm var *adenocaulon* (Haussk) Fern
Common

99 *Oenothera* sp
Numerous plants in the *biennis muricata* alliance

Umbelliferae (Ammiaceae)

100 *Cicuta bulbifera* L
Scarce

101 *Sium suave* Walt
Scarce

Cornaceae

102 *Cornus stolonifera* Michx
Very common Perhaps brought by gulls I have seen the birds eat the fruit from bushes on the shore of the Straits at Mackinaw City

Oleaceae

103 *Fraxinus pennsylvanica* Marsh var *lanceolata* (Borkh) Sarg
Not common and small

Asclepiadaceae

104 *Asclepias syriaca* L
Common throughout

Labiatae (Lamiaceae)

105 *Lycopus americanus* Muhl
Common in damper situations

106 *Mentha arvensis* L
Rather common Some plants have pure white blossoms although the majority have lilac ones

107 *Nepeta cataria* L
Scarce one colony

108 *Prunella vulgaris* L
Two or three plants near the water line 1949 evidently introduced that year

109 *Satureja acinos* (L) Scheele
Several patches in dry sandy ground

110 *Satureja glabella* (Michx) Briquet var *angustifolia* (Torr) Svenson
Common along rocky shores

111 *Scutellaria epilobiifolia* Hamil
Not common

Scrophulariaceae

112 *Linaria vulgaris* Mill
Common

113 *Verbascum thapsus* L
Rather common and frequently very tall

114 *Veronica americana* (Raf) Schwein
In damp sand scarce

Plantaginaceae

115 *Plantago major* L
A few plants on shore exposed in 1949 so probably came to the island that year Not noticed previously

Caprifoliaceae

116 *Sambucus pubens* Michx
Several young plants perhaps brought by birds which had eaten the fruit

Campanulaceae

117 *Campanula rotundifolia* L var *intercedens* (Witasek) Farw
Not common

Lobeliaceae

118 *Lobelia kalmii* L
Rather common in damp places

Compositae

119 *Achillea millefolium* L
Common
120 *Anaphalis margaritacea* (L) B & H var *intercedens* Hara
121 *Artemisia caudata* Michx
Common
122 *Aster junceus* Ait
Common
123 *Aster lindleyanus* T & G
124 *Bidens frondosa* L
Rather common on wet shores
125 *Cirsium arvense* (L) Scop
Common
126 *Cirsium pitcheri* (Torr) T & G
127 *Erigeron philadelphicus* L
128 *Eupatorium maculatum* L
129 *Eupatorium perfoliatum* L
130 *Chrysanthemum leucanthemum* L var *pinnatifidum* Lecoq & Lamotte
Very common
131 *Hieracium aurantiacum* L
Common
132 *Hieracium canadense* Michx
Scarce
133 *Hieracium florentinum* All
Common
134 *Solidago altissima* L
Common
135 *Solidago ohioensis* Riddell
136 *Solidago graminifolia* (L) Salisb
Common
137 *Tanacetum huronense* Nutt
138 *Taraxacum officinale* Weber

LITERATURE CITED

All the species in the preceding list except the thirteen to which attention was previously called have been reported specifically for Mackinac County in one or more of the following publications These include the major lists of Mackinac County plants and such other studies as cite Mackinac County specimens of species reported in this paper and not included in the major lists

Dodge, C K. "The Flowering Plants, Ferns and their Allies of Mackinac Island" *Fifteenth Rep Mich Acad Sci* (1913) 218–237, plus addenda sheet (2 pp) 1913

Dodge, C K. "Observations on the Flowering Plants, Ferns, and Fern Allies on and near the Shore of Lake Huron from Linwood Park near Bay City, Bay County, to Mackinaw City, Cheboygan County, Including the Vicinity of St Ignace Mackinac and Bois Blanc Islands, Mackinac County" Mich Geol & Biol Surv Publ 31 (Biol Series 6) 15 74 1921

Hermann, Frederick J "The Genus Carex in Michigan" *Amer Midl Nat* 25 1–72 1941

Ogden, E. C "The Broad leaved Species of Potamogeton of North America, North of Mexico" (Continuation) *Rhodora*, 45 119–163 1943

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Potzger, J E "The Vegetation of Round Island (Straits of Mackinac), Michigan' *Butler Univ Bot Studies*, 6 116–122 1944

Robertson, Betty M "Distribution of the Ranunculaceae in Michigan" *Papers Mich Acad Sci, Arts, & Letters*, 26 (1940) 31–59 1941

Voss, Edward G "Observations on the Michigan Flora A Survey of the St Ignace Causeway (Mackinac County)" *Denison Univ Bull, Jour of the Sci Lab*, 41 39–45 1948

Voss, Edward G *Ibid*, II "Some Plants New or Rare in Emmet, Cheboygan, and Mackinac Counties, Michigan" *Ibid*, 41 77–81 1949

ANNUAL REPORT OF THE OHIO ACADEMY OF SCIENCE
1950

Organized 1891 Incorporated 1892
Affiliated with the American Association for the Advancement of Science

OFFICERS AND COMMITTEES FOR 1950–1951

President

Edward S Thomas

Vice-Presidents

A *Zoology* G D Morgan
B *Plant Sciences* C C Allison
C *Geology* J O Fuller
D *Medical Sciences* C A Angerer
E *Psychology* C O Mathews
F *Physics and Astronomy* H V Knorr
G *Geography* H F Raup
H *Chemistry* G L Orr
I *Mathematics* C H Heinke
J *Science Education* Harley Ellinger
K *Anthropology and Sociology* K H Wolff

Secretary

Rush Elliott

Treasurer

R M Geist

Historian

W H Alexander

COMMITTEES

Executive Committee

Ex-Officio E S Thomas, Rush Elliott R M Geist
Elective G B Barbour, G W Blaydes

Membership

A *Zoology* A N Solberg Chairman
B *Plant Sciences* F J Bacon
C *Geology* C N Savage
D *Medical Sciences* L R Hayes
E *Psychology*
F *Physics and Astronomy* A L Lutz
G *Geography* L R Fletcher
H *Chemistry* B M Norton
I *Mathematics*
J *Science Education* C T Hathaway
K *Anthropology and Sociology* E L Reynolds

Nominating

Vice Presidents of 1949–1950, R J Bernhagen Chairman

Program

Vice Presidents of Sections and Secretary

Library

Mrs Margaret McCartney, Chairman

R A Hefner	Term expires 1951
W M Tidd	Term expires 1953

Publications

Secretary, Chairman

R A Hefner	Term expires 1951
W M Tidd	Term expires 1953

Conservation

E S Thomas	Term expires 1951
P B Sears	Term expires 1951
F J Wright	Term expires 1951
J R Beck, Chairman	Term expires 1952
R A Hefner	Term expires 1952
E L Rice	Term expires 1952
R W Dexter	Term expires 1953
R W Franks	Term expires 1953
L S Roach	Term expires 1953

Necrology

Karl Ver Steeg	Term expires 1951
H H M Bowman Chairman	Term expires 1952
Roderick Peattie	Term expires 1953

Resolutions

W C Beaver, Chairman	Term expires 1951
H R Eggleston	Term expires 1952
A W Lindsey	Term expires 1953

Trustees of Research Fund

E N Transeau Chairman	Term expires 1951
Herbert O Osborn	Term expires 1952
G B Barbour	Term expires 1953

Academy Representatives

1 On the Joint Administrative Board of the Ohio Journal of Science

R A Hefner	Term expires 1951
W M Tidd	Term expires 1953

2 On the Council of the A A A S Rush Elliott

The Council for 1950–1951

C C Allison
C A Angerer
I J Bacon
G B Barbour
J R Beck
G W Blaydes
Harley Ettinger
Rush Elliott
L R Fletcher
J O Fuller
R M Geist
I R Hayes
C I Hathaway
R A Hefner
C J Heinke
H V Knorr
F H Krecker
A L Lutz
Mrs Margaret McCartney
C O Mathews
G D Morgan
B M Norton
G I Orr
R A Popham
H F Raup
F I Reynolds
C N Savage
A N Solberg
E S Thomas
W M Tidd
E N Transeau
K H Wolfe

REPORT OF THE FIFTY NINTH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

As a part of the centennial program of Capital University the Academy was invited to meet on the campus of Capital and to enjoy the facilities of the new Science Hall The meetings were held on April 27 28 and 29 The local committee under the chairmanship of Dr R M Geist had made splendid provision for all needs The registration for the meeting hit an all time high and the quality of the meetings seems to be improving each year

Each section of the Academy had a good program and one of the outstanding features of the meeting was the second Annual Science Day of the Junior Academy This project has developed very rapidly and is proving to be an extremely valuable part of the program of The Senior Academy

The annual banquet and business meeting was held in the Refectory at Capital University on Friday evening at 6 45 Dr R M Geist served as toastmaster greetings for the host institution were extended by President Harold L Yochum and the response was given by Dr E L Rice The presidential address was given by Dr Paul B Sears on the title Conservation in Theory and Practice

The annual report of the past year's activities presented by the secretary included a most gratifying membership report Last year we had passed the 1000 mark in our total membership This year we were seven members short of the 1200 mark Two hundred sixty one new members were added in the past year an all time record for a single year Unfortunately we loose some members each year

The following persons were announced as newly elected Fellows of the Academy

Robert E Alkire
K Dale Archibald
Clifford O Berg
A H Blickle
William F Bradley
A B Brower
Thomas B Cameron
James I Corwin
George Crowl
W Merrill Davis
Clarence L Dow
Erika Eichorn
Henry C Eyster
Henry Federighi
Allen S Fox
William D Gray
C T Hathaway
Gale A Herbert
Paul W Hydell
Ruth W Hershberger
R George Jaap
Lowry B Karnes
Arthur S Kieffer
Aurele La Rocque
Ian R MacGregor
Richard H Mahard
Frank G Meserve
Dorothy Clum Morse
Everett C Myers
Stanley E Norris
Bayes M Norton
I C Pettit
John R Randall
Earle L Reynolds
John S Richardson
William I Robinson
Conrad F Ronneberg
Julia F Rothermel
Carlton N Savage
James M Schopf
G I Scott
Frank M Semans
Paul J Seyler
George T Siemens
George E Simpson
Elizabeth W Smith
William D Stull
Henry F Strohecker
Charles Summerson
Charles M Vaughn
Jacob Verduin
Herman Von Dach
John W Wargo
Clair L Worley

The report of the Nominating Committee was presented by Dr F T Bodenberg of the Necrology Committee by Dr J E Carmen and of the Resolutions Committee by Dr W C Beaver

Respectfully submitted
Rush Elliott *Secretary*

REPORT OF THE EXECUTIVE COMMITTEE AND COUNCIL

The Executive Committee met on December 9, 1949, and again on April 27, 1950, and the Council on December 10, 1949, and again on April 27, 1950

A special committee (Eugene Van Cleef, Chairman, F H Krecker and A W Lindsey) appointed to consider methods of increasing the income of the Academy and the allocation of the funds collected had reported at the Council meeting on April 21 1949 This report contained a number of recommendations which required constitutional amendments These were prepared by the secretary as instructed, were approved by the Executive Committee by vote of the Council, and final approval was voted by the Academy members in attendance at the annual business meeting One of these amendments increased the annual dues to $3 00 Another provided for Institution Memberships for colleges and Universities and twelve such memberships have been secured to date A third type of membership is Corporation Membership and four Corporations have taken memberships to date

The Council accepted with deep regret the resignation of Dr Herbert O Osborn as Chairman of the Trustees of the Research Fund and of Miss Lillian Michaelis as Librarian for the Academy

The 1951 annual meeting is to be held at Miami University on April 5, 6 and 7

Respectfully submitted
RUSH ELLIOTT, *Secretary*

REPORT OF THE TREASURER

COLUMBUS OHIO April 28 1950

To the Ohio Academy of Science

I herewith submit a financial statement of the condition of the Ohio Academy of Science as of December 31 1949 The books have been audited and the auditor s certificate is herewith attached

Respectfully submitted
R M GEIST *Treasurer*

OHIO ACADEMY OF SCIENCE BALANCE SHEET
As at December 31st 1949
ASSETS

CURRENT EXPENSE FUND			
Cash in Bank			$ 687 77
Bonds Owned			
U S War Savings Bonds—Series F (cost)		$ 111 00	
U S War Savings Bonds—Series G (cost)		1 900 00	
Total Bonds Owned			$2 011 00
Total Assets—Current Expense Fund			$2 698 77
RESEARCH FUND			
Cash in Bank		$ 224 84	
Bonds Owned			
Fort Hayes Hotel—Columbus Ohio (cost)	$1 300 00		
U S War Savings Bonds—Series G (cost)	300 00		
Total Bonds Owned		1 600 00	
Banc Ohio Securities Company Stock		437 50	
Total Assets—Research Fund			2 262 34
Total Assets			$4 961 11

LIABILITIES AND NET WORTH

LIABILITIES		
CURRENT EXPENSE FUND		
Deferred Credits to Dues— 1950 Dues Paid in 1949		$ 47 50
NET WORTH		
Ohio Academy of Science		
Current Expense Fund	$2 651 27	
Research Fund	2 262 34	
Total Net Worth		4,913 61
Total Liabilities and Net Worth		$4 961 11

OHIO ACADEMY OF SCIENCE STATEMENT OF INCOME AND EXPENSE

For the Year Ended December 31 1949

CURRENT EXPENSE FUND

INCOME			
Membership Dues 1949 and Prior Years			$2 362 50
Sale of Publications			46 55
Interest on Bonds			47 50
Refunds—Surety Bond			89
Total Income			$2 457 44
EXPENSES			
Subscriptions Ohio Journal of Science		$1 326 00	
Printing Proceedings 1949	$ 107 90		
Printing Office Supplies	156 51		
Printing Other	309 28		
Total Printing Expense		573 69	
Honorarium—Secretary		160 00	
Postage Telephone and Office Expense		89 15	
Bank Charges		20 45	
Auditing		25 00	
Bond Treasurer		5 00	
Total Expenses			2 199 29
Excess of Income Over Expense			$ 258 15

RESEARCH FUND

INCOME		
Grants for Research A A A S		$ 236 25
Interest on Bonds		65 75
Dividends Received		12 50
Total Income		$ 314 50
EXPENSES		
Grants for Research	$ 309 18	
Plates for Knull Article Ohio Journal of Science	17 27	
Bank Charges	2 32	
Total Expenses		328 77
Excess of Expense Over Income		$ 14 27

AUDITOR S CERTIFICATE

COLUMBUS OHIO April 1 1950

The Ohio Academy of Science Columbus Ohio

GENTLEMEN

Pursuant to your instructions I have examined the accounts and records of the Treasurer of the Ohio Academy of Science for the year ended December 31 1949

A detailed audit was made of all transactions handled by the Treasurer Cash in bank was verified by bank certification Securities in safety deposit box were verified by personal examination My examination was made in accordance with generally accepted auditing standards

In my opinion the accompanying balance sheet and statements of income and expense (cash basis) fairly represent the financial position as at December 31 1949 and the results of operations on a cash basis for the year ending December 31 1949 These statements are in conformity with generally accepted accounting principles

Respectfully yours
D M SHONTING
Certified Public Accountant

REPORT OF THE TRUSTEES OF THE RESEARCH FUND

Columbus, Ohio, April 27, 1950

To the Ohio Academy of Science

The Trustees of the Research Fund present the following Report on the receipts and expenditures during the year 1949

Receipts

Bank Balance on January 1, 1949	$239 11	
Received from the A A A S	236 25	
Received from Investments	78 25	
Total Income		$553 61

Expenditures

March 30—To Joseph R Stratton University of Toledo for establishing and maintaining an experimental colony of guinea pigs	$ 48 00	
August 6—To John F Hopkins Oberlin College, for aid in collecting peat samples in Canada	236 18	
August 6—To Joseph Knull Ohio State University, for illustrations in the Ohio Journal of Science	17 20	
December 20—To Ralph Dexter, Kent State University for field study of Fairy Shrimps	25 00	
Bank Charges	2 39	
Total Expenditures		$328 77
Bank Balance on January 1 1950		$224 84

There will therefore be several hundred dollars available for research aid during this year

Respectfully submitted,
E Lucy Braun
Herbert Osborn
E N Transeau, *Chairman*

REPORT OF THE LIBRARY COMMITTEE

Nine new exchanges were added to the list in 1949 Two were dropped for failure to send anything in return The Business Manager removed most of the Chinese addresses which remained because of postal problems

Sale of publications amounted to $46 55 That amount has been turned over to the Treasurer of the Academy

Respectfully submitted
Lillian Michaelis *Librarian*

REPORT OF THE JOINT ADMINISTRATIVE BOARD OF THE OHIO JOURNAL OF SCIENCE

A special meeting of the Joint Administrative Board of the Ohio Journal of Science was held in Columbus, Ohio October 15 1949 Those present were Drs Spieker and Meyer representing the Ohio State University Drs Hefner and Tidd representing the Ohio Academy of Science and Drs Blaydes and Popham representing the Ohio Journal of Science

Dr Popham presented facts and figures concerning the financial status of the Journal Following this report the Board voted to increase the subscription rate of the Journal to $4 00 per year effective as soon as practicable The price of all back issues of the Journal was set at $1 00 per copy, and the price of all back volumes was set at $4 00 per volume The Business Manager was authorized to accept advertising for the Journal, the details of rates and kinds of advertising to be left to the discretion of the Business Manager

The Board requested that the Council of the Ohio Academy of Science deposit a copy of the minutes of its meetings with the secretary of the Joint Administrative Board of the Journal The Editor of the Journal was directed to contact the Vice-President of each section of the Academy each year and to encourage him to secure papers from his own field of science for publication in the Journal

Dr Spieker made a progress report concerning the selection of the new Editor for the Journal A discussion followed

There being no further business, the Board was adjourned

Respectfully submitted,
Richard A Popham
Secretary of the Board

REPORT OF THE JOINT ADMINISTRATIVE BOARD OF THE OHIO JOURNAL OF SCIENCE

The annual meeting of the Joint Administrative Board of the Ohio Journal of Science was held in Columbus, Ohio, April 25, 1950 Those present were Drs Spieker and Meyer representing the Ohio State University, Dr Tidd representing the Ohio Academy of Science, and Drs Blaydes Popham and Bohning representing the Ohio Journal of Science Dr Hefner an Academy representative, was unable to attend

Following the election of Dr Spieker as Chairman of the Board, the minutes of the preceding meeting were read and approved

Dr Blaydes was elected to serve as Editor for Volume 50 of the Journal Dr Popham was elected Business Manager, and Dr Bohning was elected Advertising Representative The Board authorized the Editor to appoint an Associate Editor, in charge of book reviews, and recommended that the number of book reviews per volume be increased

The report of the Business Manager was mainly in the form of a financial statement for Volume 49, a copy of which is attached to this report The Editor Dr Blaydes, reported that a total of 41 papers covering 252 pages were published in Volume 49 The papers were contributed from 13 different fields of science Five book reviews were also printed There were 15 manuscripts on hand at the end of the year Both reports were accepted and filed

Dr Bohning presented an informal report of the Advertising Representative, indicating that 289 companies have been contacted regarding the placing of ads in the Journal He reported that ads had been obtained from 11 companies and that many have asked to be contacted in the fall, at which time they will determine their 1951 advertising budgets He also called attention to the fact that the cost of securing advertising was very high, and that to date the Journal had not realized a net profit from this operation

The Board established a policy of electing the Vice-Presidents of the various sections of the Academy to positions as members of the Editorial Board for the period of their service as Vice-Presidents

The Editor once again asked that the section Vice Presidents of the Academy be on the alert during their programs for papers suitable for publication in the Journal The Editor requested that such titles and authors be referred directly to him by the section Vice Presidents

There being no further business, the Board adjourned

Respectfully submitted,

RICHARD A POPHAM
Secretary of the Board

THE OHIO JOURNAL OF SCIENCE

Fiscal Year 1949

RECEIPTS	
Bank Balance, Feb 23, 1949	$ 238 87
Ohio State University—Paid for Subscriptions	1 300 00
Ohio Academy of Science—Paid for Subscriptions	1,390 50
Non members—Paid for Subscriptions	152 50
Sale of Separate Numbers, Volumes, and Reprints	518 22
Authors—Paid for Plates	152 88
Ohio Academy of Science—Paid for Annual Report	107 90
Authors and Institutions—Paid for Printing	100 00
	$3,960 87

EXPENDITURES	
Spahr & Glenn—Printing Journal	$3,003 30
Spahr & Glenn—Mailing Envelopes	82 60
Bucher Engraving—Plates	295 59
Postage and Express	187 95
Office Supplies and Bank Charges	151 31
Refunds	2 50
Secretary and Labor	38 70
Bank Balance, Jan 18, 1950	198 92
	$3,960 87

REPORT OF THE COMMITTEE ON CONSERVATION

The Conservation Committee held two meetings during the past year to plan appropriate activities and to discuss conservation matters relating to the Academy Both meetings were held at Columbus Ohio, on December 10 1949 and February 4, 1950 respectively The Committee following its December 10th meeting recommended to the Council that the Ohio Academy of Science conduct a symposium on conservation at the annual meeting and that the Academy express to the Director of the newly created Ohio Department of Natural Resources support in the development of an effective conservation program in the state Both recommendations were approved by the council and have been put into effect the former by the symposium planned for presentation at 4 15 P M Friday, April 28, in Troutman Hall Capital University and the latter by an appropriate letter from the Secretary to Mr A W Marion Director of the Department of Natural Resources

The Committee in planning this first conservation symposium felt that it should logically be the fore-runner of a series of such symposia designed to acquaint the membership of the Academy with conservation problems, programs and progress in the state The first symposium is planned to present an over-all picture of the organization of the Department of Natural Resources created by Amended Senate Bill Number 13 passed by the last General Assembly of the State of Ohio and of the water and geological survey division of that department It is the hope and recommendation of the Committee that similar symposia be held in subsequent years on other aspects of conservation

The Committee also plans to hold an informal discussion with a group of persons concerned with education administration to consider an approach to the large problems of developing a significant program of conservation education in the public schools of the State This meeting is tentatively planned for mid May of this year

The Committee feels that the Ohio Academy of Science has an opportunity to be of real service to the conservation program of the state through offering appropriate leadership and guidance To this end it is our belief that the Committee could be made more effective if its membership included representatives of all the fields directly concerned with resource management We, therefore, recommend that an effort be made through subsequent appointments to the Committee to see that adequate representation is given to the fields of soil, water, forest, mineral and wildlife conservation

Respectfully submitted

R V Bangham, F L Rice
James R Beck P B Sears
R W Franks, E S Thomas
R A Hefner Frank J Wright
Charles A Dambach, *Chairman*

REPORT OF THE COMMITTEE ON NECROLOGY

The Committee on Necrology reports with deep regret the death of five members of the Academy since the last annual meeting The following memorial statements were written by colleagues of the deceased members as indicated by the name following each statement

Respectfully submitted

H H M Bowman
Karl Ver Steeg
J Ernest Carman *Chairman*

Edmund Secrest

Dr Edmund Secrest director of the Ohio Agricultural Experiment Station from 1937 to 1947 and former State Forester, died November 28, at Ford Hospital in Detroit following a brain operation He was 68

Dr Secrest was known as the father of forestry in Ohio The present forestry program which has created thousands of acres of state owned land was developed under his personal direction Several months ago he was named chairman of the new forestry research department at the Station when the Division of Forestry was transferred to the new Ohio Department of Natural Resources Dr Secrest was also a member of the Ohio Strip Mine Commission

Dr Secrest was born at Randolph, Kansas, and was a graduate of Kansas State College He was awarded honorary doctor of science degrees by the Kansas State College and the College of Wooster At the time of his death he was serving as a member of the board of trustees of the College of Wooster He was a member of the Society of American Foresters, the Association of State Foresters, the Ohio Academy of Science, and the Ohio Forestry Association

During his years in forestry in Ohio, Dr Secrest was the author of several bulletins, presented numerous speeches on forestry before technical and other groups, and was the author of the statutes of the general code of Ohio relating to forestry

He is survived by his wife and two daughters, Mrs Mary Hoover Shibley, of Lakewood, and Edith, a student in Philadelphia Burial was made in the Wooster, Ohio, cemetery

—*O D Diller*

JOHN A TOOMEY

Dr John A Toomey died of cerebral hemorrhage in Cleveland City Hospital on New Year s Day, 1950 Born in Cleveland in 1889, his entire life was spent in his native city He received from St Ignatius College an A B degree in 1910, and a Master s degree in 1912 After acquiring an LL B degree from the Cleveland Law School in 1913, he decided to enter the profession of medicine, and graduated from the Western Reserve University Medical School in 1919 In 1949 he received an honorary LL D from John Carroll University

At the time of his death he was Professor of Clinical Pediatrics and Contagious Diseases at Western Reserve University having served his Alma Mater as chief of the City Hospital Contagious Diseases and Pediatrics Division for 29 years

He was a member of many scientific and professional societies including the Ohio Academy of Science, the American Academy of Pediatrics (president 1949) the American Pediatrics Society, the Society of American Bacteriologists, the American Medical Association, the Ohio State Medical Society and the Cleveland Academy of Medicine

He served his local medical society with great distinction as a member of the Board of Directors and as chairman of several scientific divisions of the Academy, including the Pediatric, Practice of Medicine and Experimental Medical sections In 1947–48 he was president of the Western Reserve University Medical Alumni Association Although Dr Toomey gave generously of his time in service to these various organizations, his greatest achievements were attained as a scientist a teacher, and a medical consultant

As a scientist his interest was devoted to fundamental problems in the epidemiology, immunology, and therapy of contagious diseases Among his 350 published papers, 143 were devoted to his researches and clinical observations on poliomyelitis and he was among America's greatest students of this disease His basic observation that the chief portal of this specific virus into the body is by way of the gastrointestinal tract has been accepted as a proven fact This work remains as his greatest scientific discovery Likewise by developing many original methods of therapy in poliomyelitis he was able to diminish the mortality and to lessen complications in his patients to a degree not hitherto reached

As a teacher he excelled because of his broad knowledge of contagious diseases His clear, colorful and practical method of presenting his subject was a great inspiration to all of his students His exceptional ability as an instructor gained him the highest respect of all of his professional colleagues

As a consultant as well as a scientist and teacher, he possessed three important attributes of character—he had a broad sympathy for the patient, he was a hard and diligent worker and he was honest This combination of virtues made him a tower of strength to the patient and his relatives as well as to the family physician

Honoring his memory, the Unit for Contagious Diseases at the Cleveland City Hospital has been named the "Toomey Pavilion " An editorial in the Cleveland *Plain Dealer* of January 3 1950 expresses the high regard that Dr Toomey held in the hearts of Cleveland citizens "If there was a fighter of heroic proportions against that enemy of mankind contagious disease, that fighter was John A Toomey By his death this city has lost one of its greatest citizens one of its greatest native sons a man whose fame in the profession of medicine extended the world around

The death of Dr John A Toomey is of immeasurable loss to his patients and to his dear friends and colleagues —*Dr John Tucker*

MARVIN PITTMAN

Marvin Pittman, born April 1919 at New Iberia, Louisiana, received the B S degree from Duke University, 1940, and the M S in Geography at the University of Chicago, 1946

He served as bomber pilot and navigator during the war and was shot down over Germany He was twice captured and twice escaped from German prison camps He became part of the Jugoslav underground and was picked up by the Russians near Vienna near the close of the war

During the year 1948–49 Mr Pittman was Assistant Professor of Geography at Miami University He then joined the faculty of the University of the Philippines During the Christmas holidays of 1949, Pittman and another Professor at this University went on a tramping trip into the Igorot County, Ifugao subprovince On Christmas day, 95 km north of Baguio, the two men were speared to death by a band of Ifugao headhunters Pittman is survived by his wife and infant daughter, and by his parents at Statesboro, Georgia

—*W H Shideler*

LESLIE L PONTIUS

In the death of Leslie L Pontius Ohio lost one of its outstanding field naturalists He was born in Tarlton Pickaway County, Ohio, where he spent his boyhood and received his education in the village school

Mr Pontius taught for several years in the rural schools of Pickaway County and later was engaged in the drug business in Columbus In 1913 he entered the Postal Service in Circleville, Ohio where he remained for more than thirty years and at the time of his retirement was Assistant Postmaster

He had a general knowledge of, and enjoyed all forms of Natural History Although having no specialized training in botany he had a vast knowledge of what grows in the fields and woods and on the hills of Ohio He could recognize without a moment's hesitation many of the plants that grow in the state Working with his farmer friend and field companion, Mr Floyd Bartley of near Circleville, many new records have been added to the list of Ohio plants Mr Pontius is known throughout the state as one of its outstanding field botanists Plants collected by him can be found in many Universities and Museums, including Smithsonian Institute at Washington, D C , and New York Botanical Gardens with which he was a collaborator His entire herbarium has been placed at Ohio University at Athens Ohio

Mr Pontius was an active member of many societies, including the Ohio Academy of Science, Wheaton Club, Audubon Society, Wilson Ornithological Society and the local Garden Clubs He was an active member and Trustee of the First Methodist Church in Circleville and will long be remembered by his many friends for his good judgment and understanding of people —*Floyd Bartley*

John Paul Visscher

John Paul Visscher professor of biology in Western Reserve University, a distinguished teacher and a leading authority on the general physiology and behavior of the lower organisms, died on February 11, 1950

For more than twenty five years Professor Visscher s life and work exerted a profound influence on the teaching of biology in the University and through his students in the city and northern Ohio During this time he carried on an active interest in research on marine animals and contributed widely to the local associations interested in biological subjects

Dr Visscher was born in Holland Michigan September 19, 1895 and was graduated from Hope College, Holland, with the B A degree in 1917 He promptly enlisted in the Army, Chemical Warfare Service and was discharged as a second Lieutenant in December, 1918 On leaving the Army he continued his studies in biology at the John Hopkins University completing work for the M A degree in June 1920 After two years as instructor in zoology, Washington University St Louis, he returned to John Hopkins in 1922 as Bruce Fellow and received his Ph D degree in 1924 During the summer months of his training period, Dr Visscher carried on research on barnacles at the Marine Biological Laboratory, Woods Hole, resulting in a series of publications on the physiology and life cycle of Cirripedia In connection with this work he studied marine life at the biological stations of Naples Italy in the Laboratory of the Marine Biological Association of the British Empire Plymouth in the Marine Station of the Dry Tortugas, and in the Pearl Harbor Naval Station

Appointment to the Biology Department at Western Reserve University in 1924 to work with Professor Herrick, introduced the next important phase of Dr Visscher s work The work under way in the department in the field of Ornithology received his full support and resulted in the Baldwin Bird Research Laboratory and contributed to the establishment of a strong active society for the study of bird life in the city of Cleveland

Dr Visscher s accomplishments his quality of mind and character gained for him wide recognition and many honors He was elected a member of the American Society of Naturalists American Society of Zoologists Fellow of American Association for the Advancement of Science Fellow, Ohio Academy of Science Sigma Xi and Phi Beta Kappa He served as a trustee of the Cleveland Museum of Natural History and the Garden Center of Greater Cleveland He served as President of the Cleveland Bird Club for two terms and as president of the Wild Flower Club of Cleveland —*Franklin J Bacon*

REPORT OF COMMITTEE ON RESOLUTIONS

Be it Resolved, that the members of the Ohio Academy of Science express to President Harold L Yochum of Capital University, and to the members of the local committee, their appreciation of the hospitality so freely extended and the fine facilities furnished, which have made our fifty-ninth annual meeting so successful and pleasant

Be it Resolved, that the Ohio Academy of Science express to President Yochum and the faculty of Capital University its felicitations on the one-hundredth anniversary of this notable and distinguished institution of learning

Be it further Resolved, that the Ohio Academy of Science record its deep appreciation for the devoted services of Dr Herbert Osborn who is retiring as Chairman of the Trustees Research Fund after many years of membership in that committee and for his numerous contributions to our organization in general, and to the field of science in the world at large

Respectfully submitted,
P B Sears,
H R Eggleston
W C Beaver, *Chairman*

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THE OHIO JOURNAL OF SCIENCE

VOL L SEPTEMBER 1950 No 5

THE ORIGIN AND DEVELOPMENT OF THE OHIO STATE UNIVERSITY WITH SPECIAL REFERENCE TO THE BIOLOGICAL SCIENCES[1]

LOIS LAMPE
The Ohio State University
Columbus Ohio

I BEGINNINGS

The Morrill Act establishing the Land Grant Colleges was signed by Abraham Lincoln July 2 1862 The gift of public lands was accepted by the Ohio Legislature in 1864 and at the same time the responsibility of establishing and maintaining an Agricultural and Mechanical College Provision was made concurrently for the first Board of Trustees twenty one in number They first met in the office of Governor Rutherford B Hayes where they discussed and pondered upon what the college should be At a later meeting Mr Joseph Sullivant reiterated that he was in favor of a broad and liberal foundation and that if the Board had the means he would teach all that was worth knowing The difference of opinion held then gradually wore away and to a great degree the concept of Mr Sullivant and others like him has prevailed throughout the school

The college was located in Franklin County in 1870 and on the William Neil farm north of Columbus in 1871 331 11 acres were purchased The course of study was decided upon January 5 1871 and it was the same that Mr Sullivant had proposed at an earlier session The same day the Trustees accepted Mr Sullivant s drawing for the Seal of the College The contract for the building was let the following July University Hall as it was later called was built just north of a spring of clear cool water

A faculty of seven members was elected in January and April 1873 They were present when school opened on September 17th and seventeen students came Others arrived the next day and by the end of the school year about fifty students had been accepted Some of the young people being considered unqualified to enter were turned away

THE FIRST FACULTY OF THE OHIO AGRICULTURAL AND MECHANICAL COLLEGE 1873

- Mr Edward Orton President and Professor of Geology Mining and Metallurgy
- Mr Thomas C Mendenhall Professor of Physics and Mechanics
- Dr Sidney A Norton Professor of General and Applied Chemistry
- Mr Joseph Milliken Professor of English and Modern Language and Literature
- Dr Norton S Townshend Professor of Agriculture and Botany
- Mr John H Wright Assistant Professor of Ancient Languages and Literature
- Mr Robert W McFarland Professor of Mathematics and Engineering

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[1] Papers from the Department of Botany and Plant Pathology The Ohio State University No 520

Subjects anticipated to be taught by Joseph Sullivant and later by the Board of Trustees were Zoology and Veterinary Science, which were introduced in 1874 and 1885 respectively, and Political Economy and Civil Polity, added in 1875 The Horticulture and Vegetable Physiology originally prescribed were apparently included in Botany at the time

By 1878, the College had been reorganized with change in politics three times, the changes affecting the Board of Trustees rather than the Faculty The last time, however, the name of the institution was changed to The Ohio State University and the Board was again reduced to seven members

In the seventy-seven years which have apssed since 1873, a gradual expanding in all the areas of learning in the University has occurred It may be seen in the subdivision of existing departments, which has happened time and again, and in the creation of others The foundation of each new department has usually been laid in courses already being taught, the need for the new department finally becoming evident The expansion in biology illustrates the growth process apparent throughout the University during the years

II THE EVOLUTION OF THE BIOLOGICAL DEPARTMENTS

Dr Norton S Townshend was Professor of Agriculture and Botany in the first faculty of 1873 The Department of Horticulture and Botany was formed in 1880, Professor A P Morgan Chairman, and Professor William R Lazenby, his successor in 1881 This department was resolved into two others in 1891, the Chair of Horticulture being retained by Professor Lazenby The new Chair of Botany and Forestry was accepted by Professor William A Kellerman the same year

The forestry division was returned to the Department of Horticulture in 1894 where it remained until 1908 At that time it was set up as a separate department, the chairmanship being assumed by Professor Lazenby The Department of Horticulture passed to the headship of Professor Wendell Paddock in 1909 Professor Lazenby died in 1916, and the next year the two departments were merged Professor Paddock in charge

The expanding Department of Horticulture and Forestry came under the chairmanship of Dr J H Gourley in 1929 and after his death, of Dr Freeman S Howlett in 1947

The Department of Botany passed to the chairmanship of Professor John H Shaffner in 1908 It has continued to flourish under the subsequent headships of Dr Edgar N Transeau, 1917 and Dr Bernard S Meyer, 1946 The name of this department was changed in 1946 to the Department of Botany and Plant Pathology

The Chair of Zoology and Comparative Anatomy was created in 1874 and accepted by Professor Albert H Tuttle He was succeeded by Professor David S Kellicott in 1888 In 1891, this department was enlarged and divided, Professor Kellicott becoming Chairman of the Department of Zoology and Entomology and Dr A M Bleile, Chairman of the Department of Anatomy and Physiology

The Department of Zoology and Entomology has continued its growth under the headships of Drs Herbert Osborn, 1898, Raymond C Osburn, 1917, Laurence H Snyder, 1942, and David F Miller, 1947

III AGENCIES IN BIOLOGY AND RELATED SCIENCES ORIGINATING AT THE OHIO STATE UNIVERSITY

Through the action of faculty members, ever mindful of widening opportunity and service, numerous organizations have arisen at the University which have played their part in the development of the Biological Sciences at the University and in the State They are

1 *The Ohio Agricultural Experiment Station* The Station was authorized by the Ohio Legislature, April 17, 1882 Professor William R Lazenby of the University was its sponsor and first director It was moved from the University to

near Wooster, Ohio, in 1891, with Mr C E Thorne, Director In recent years a growing co-operation between the University and the Station has been occurring both in administration and in research Dean Leo L Rummell of the College of Agriculture of the University is also the Director of the Station

2 *The Biology Club* The club began under the name of the Biological Club of The Ohio State University and the Ohio Agricultural Experiment Station Its first minutes were recorded in 1891 It continues to hold meetings throughout the school year The most notable achievement of this club was the founding of the state Academy Dr W D Gray is the current President

3 *The Ohio Academy of Science* The Academy was organized in 1891 and it was incorporated, March 12, 1892 Its publication of reports and research papers began the same year and continued through 1902 in the four volumes of *Annual Reports* The ensuing Annual Reports together with some papers, continued through 1930 in the five volumes of the *Proceedings* The name of the Academy was shortened from the Ohio State Academy of Science in 1909

The first volume of the *Ohio Naturalist*, official organ of the Academy, was published in 1903, and it covered the period after 1900 This volume and the next four were published by the Biological Club The Ohio Naturalist became the *Ohio Journal of Science* in 1915, the official organ of the "Ohio State Scientific Society" and the Ohio Academy of Science By 1927 the society was forgotten, and the Academy and the Journal were entirely freed of reference to their origin The Journal contains the Annual Reports of the Academy since 1930 It is now in its fiftieth volume of the complete series This journal has become a most valued medium of communication and exchange throughout the world

Dr Edward S Thomas is currently President of the Academy, and Dr Glenn W Blaydes continues as Editor of the *Journal* since 1941

4 *Franz Theodore Stone Institute of Hydrobiology* The history of the Lake Laboratory began with an idea of Professor David H Kellicott in 1891 His hopes were realized in 1896 when a second story was completed on the State Fish Hatchery Building at Sandusky, Ohio It was used by him and his students that summer This laboratory has grown in size and service, has had four different sites, and today exists as the Franz Theodore Stone Laboratory on Gibraltar Island, Put-in-Bay, Ohio Eighty-six known papers emanating from research carried on in this laboratory had been published by 1928 when the contributions began The story of the growth of the laboratory, written by Dr Thomas H Langlois, its Director, may be found in the latest *Contribution*, No 11 This Institute was authorized in 1950

5 *The Ohio Biological Survey* The idea of the Survey originated with members of the Ohio Academy of Science, and it was proposed through the agency of the Academy, to the Board of Trustees of the University The Survey was authorized in 1912, and has issued forty-one Bulletins dealing with the biology of Ohio Dr Herbert Osborn has continued as Director since the origin of the Survey

6 *The Plant Institute* The institute was organized in 1921 at the suggestion of Dr Edgar N Transeau, to include all the plant science departments of the College of Agriculture of the University Reports by faculty members and graduate students of the Departments of Botany and Plant Pathology, Horticulture and Forestry, Agronomy, Agricultural Biochemistry, and more recently of Agricultural Engineering, have been presented through the years Today the meetings are held bi-weekly throughout the school year Invitation speakers from other institutions are occasionally sponsored by the Institute and the Graduate School Dr Richard A Popham is Chairman

7 *The Columbus Entomological Society* This society was founded in 1936 by Dr Frank L Campbell and other entomologists and graduate students in the Department of Zoology and Entomology It was organized to promote scientific and social activity among all the entomologists of the Columbus area Monthly meetings are held during the school year Mr Howard Hintz is President

8 *The Institute of Nutrition and Food Technology* This institute was established in 1946 to facilitate the instruction of students, to promote research, and to foster closer co-operation in this field of endeavor by the University and the Ohio Agricultural Experiment Station Dr Thomas S Sutton is Director

9 *The Institute of Genetics* The Genetics Seminar began at the University under the guidance of Dr [redacted] mental, and has held weekly meetings during the school years This seminar group is the nucleus of the Institute of Genetics which was created by the University in June, 1950 The latter will co-ordinate teaching and research in genetics, and will sponsor the programs of research in genetics carried out by the University and the Ohio Agricultural Experiment Station Dr David C Rife is Chairman

IV THE OHIO STATE UNIVERSITY

1949–1950

To contemplate today the open expanse of the Neil Farm as it became the home of the future Ohio State University on October 13, 1870, and to do so in the light of all that has transpired here which has made the University what it is today, is to perceive a wonder in accomplishment

As in the sister Land Grant Colleges and Universities, the achievement has been brought to pass by the concerted efforts of devoted people, wise in the long run, some responsible for its development and others supporting it with funds and good will

At the end of the Spring Quarter 1950 we find

41	deans, junior deans and directors
1,289	members of the faculty who serve full time
410	members of the faculty who serve part-time
996	assistant instructors, assistants and graduate assistants
2,736	The Total Faculty
2,216	non-teaching Personnel
88	Departments of Instruction
21,691	men students registered
6 599	women students registered
28,290	The Student Body Of these
5,433	students registered in the Graduate School
5 801	Bachelor's Degrees granted during the year
794	Master's Degrees
229	Doctor of Philosophy Degrees
836,900	Books in the Library June 9th, 1950
$339,274 39	Amount of the Development Fund, 1949
417	acres, the Campus
383	acres, the University Air Port
295	acres, the University Golf Course
1,009	acres, the University Farm
2,104	The Total Acreage of the University
$43,237,774 03	the value of the Physical Plant of the University

The value of the service of the University is incalculable, and to that its 80,942 Alumni would testify

SOURCES

1 History of the Ohio State University, edited by Thomas C Mendenhall Volume I, 1920, and Volume II 1926 The Ohio State University Press Columbus

2 Memory, current records and interviews

WAYS OF IMPROVING THE MALE FROG TEST FOR PREGNANCY

M L GILTZ AND D F MILLER
Department of Zoology and Entomology, Ohio State University,
Columbus, Ohio

It is the purpose of this paper to present some observations on emission of spermatozoa by the leopard frog, ***Rana pipiens***, which are pertinent to the procedures used in applying these animals to pregnancy diagnosis These observations indicate methods of increasing the accuracy of the test by lowering the percentage of false negatives and by avoiding possible false positives

The male leopard frog, ***Rana pipiens***, was first reported as a test animal for pregnancy by Wiltberger and Miller (1948) and Robbins and Parker (1948) Pregnancy is indicated when mature living spermatozoa appear in the urine of the frog (designated as positive) following the subcutaneous injection of 4 cc of first morning urine Absence of spermatozoa (designated as negative) indicates no pregnancy The validity of the male frog test for pregnancy has been verified by Bodine et al (1950), Maier (1949) and Brody (1949)

The results of further experiments in our laboratory indicate that factors such as the quantity of liquid injected, the salinity of the liquid, the season of the year, the temperature of the room in which they sit during the test and conditions of storage and handling are influential in their sensitivity

We have induced discharge of spermatozoa in the laboratory by injections of dilute liquids and by rapid absorption of water following drying Hundreds of frogs were injected with 7 cc or more of various liquids such as distilled water, tap water and pond water and over 50 per cent discharged mature living spermatozoa with their urines Accordingly experiments were devised to determine the extent of these factors in influencing discharge of spermatozoa and their possible effects upon the use of male frogs in clinical practice

METHODS AND MATERIALS

Except where otherwise stated, the frogs, ***Rana pipiens***, used in these experiments were delivered by express from commercial dealers and placed in aquaria containing about one inch of tap water These aquaria were then placed in a refrigerator where the temperature was maintained at approximately 45° F They were used in the experiments from two to sixty days after refrigeration began All injections were subcutaneous into the lateral lymph sacs Microscopic examinations for spermatozoa were made by removing, with a pipette, a drop of fluid from the jars in which the frogs urinated after injections If a frog failed to urinate after 90 minutes, pressure was applied to the sides of the frog which usually emptied the urinary bladder

THE POSSIBILITY OF FALSE POSITIVE DIAGNOSIS

Robbins and Parker (1949), while checking the source of false positives when using ***Xenopus laevis***, have found that ***Rana pipiens*** as well as ***Xenopus laevis*** responds to some adrenergic substances by emitting spermatozoa However, since the adrenergic substances to which ***Rana pipiens*** responded are not known to be present in human urines they discount them as a possible source of false positives

The absence of false positives in the literature indicates that if they occur they are recognized as such because of abnormalities in the animal or faulty procedures Thousands of urines of frogs have been examined in our laboratory and, except for the conditions to be mentioned below, the indications are that frogs kept in the laboratory under conditions conducive to longevity do not discharge spermatozoa unless gonadotropic substances are administered

One of the conditions to be mentioned is the effect of injections of large quantities of liquids An experiment was carried out to determine the minimum quantity of water necessary to stimulate spermatozoa emission

Four to twelve cc of *distilled* water were injected into 14 frogs of average size and their urines examined for spermatozoa The results are found in Table I A separation of the March and June data indicates that the danger of false positives due to large quantities of dilute solutions is greater in March than in June, in other words greater before the end of overwintering than after the breeding season

TABLE I

THE RESULTS OF INJECTIONS OF VARIOUS AMOUNTS OF DISTILLED WATER

Amount of cc in Distilled Water	4	5	6	7	8	9	10	11	12	Totals
IN MARCH										
Number emitting spermatozoa	0	3	4	2	3	5	2	6	6	31
Number not emitting spermatozoa	7	4	3	5	4	2	5	1	1	32
Death	0	0	0	0	0	0	0	0	0	00
IN JUNE										
Number emitting spermatozoa	0	0	0	2	1	0	2	4	4	13
Number not emitting spermatozoa	6	7	7	5	6	6	5	3	3	48
Death	1	0	0	0	0	1	0	0	0	2

In order to check the possibility of obtaining false positives from large amounts of urines, 10 cc amounts of human male and non-pregnant female urines were injected into thirty frogs Since it has been our experience that a large quantity of urine usually kills the frog, we also decided to check the effect of a non-toxic saline solution Ten cc amounts of cold-blooded Ringer's solution were injected into 30 frogs Thirty frogs received in the same shipment and stored under the same conditions as the other two groups, were injected with 10 cc amounts of distilled water The results are found in Table II

TABLE II

THE RESULTS OF INJECTIONS OF 10 CC OF NON PREGNANT URINES, RINGER S SOLUTION AND DISTILLED WATER

Number of Frogs	Injected with 10 cc of	Results		Death
		Positive	Negative	
30	Non-pregnant Urines	0	12	18
30	Ringer s Solution	1	29	0
30	Distilled Water	18	12	0

An analysis of these data suggest a remote possibility of obtaining a false positive even with a large quantity of saline solution It does not eliminate the possibility of large quantities of dilute non-lethal urines inducing emission of spermatozoa This was observed under controlled conditions in our laboratory It resulted when an injection of 7 cc of dilute urine from a non-pregnant woman followed one hour later by an injection of 10 cc of the same urine This case was not considered a false positive because the abnormally high amount of urine injected would not have been used clinically

Another condition likely to result in a false positive diagnosis concerns the condition of the frogs Our experiments indicate that abnormally dry frogs may emit spermatozoa following their introduction into water In the winter and spring of 1950 some frogs were placed in jars without water When they had lost about 35 per cent of their previous weight, water was added and four hours later their urine was found to contain mature living spermatozoa Control frogs were subjected throughout the experiment to the same environmental conditions except that they sat continuously in about one inch of water These frogs did not emit mature living spermatozoa

Frogs are usually received from commercial suppliers with a near normal water content Hundreds of these have been examined by us upon their arrival, after they were placed in tap water at room temperature, and after refrigeration None have ever discharged mature living spermatozoa However, when very dry frogs are placed in tap water after arrival in early spring they have been seen to clasp and an examination of their urines revealed, in some cases, mature living spermatozoa This indicates the necessity of care in preserving the water content at all times, of a conditioning period if received dry, and of checking all frogs before their use as test animals for pregnancy The checking is quite simple and is practiced routinely in many clinical laboratories

CONDITIONS INFLUENCING FALSE NEGATIVES

A false negative diagnosis may arise from a low sensitivity of the frog or an insufficient amount of gonadotopin, or a combination of both of these conditions The lowest percentage of false negatives occurs from urines of women in the first trimester of pregnancy It was shown by Miller and Wiltberger (1948) that there is a declining and fluctuating amount of chorionic gonadotropins after the first trimester of pregnancy Bodine et al (1950) reported no negative responses from the first trimester of pregnancy They also found the amount of chorionic gonadotropin was highest during the 2nd and lowest during the 6th month of pregnancy

TABLE III

The Influence of Chorionic Gonadotropin on Emission of Spermatozoa at Various Temperatures

Temperature of	60	67	75	85	95
Number emitting spermatozoa after 90 min	17	19	16	11	11
Number emitting spermatozoa after 120 min	17	19	18	16	12
Number in which death occurred	0	0	0	0	4

From these investigations it appears that maximum accuracy should be obtained by using urines from the first trimester and by using concentration procedures, which increase the amount of gonadotropins without injecting large quantities of solution Wiltberger and Miller (1948) suggested the possibility of a seasonal variation of the frogs and Sampson (1950) reported a seasonal sensitivity to chorionic gonadotropin

Some experiments were carried on by us which indicate that the sensitivity of the frog can be influenced by several factors under the control of the technician The results of our investigations with liquids and chorionic gonadotropins in the summers of 1948 and 1949 indicate that the frogs did not emit spermatozoa as often when they were placed, after injections, in a room where the temperature was high (i e , 90° F) In order to determine whether the temperature at which the frogs were placed during the test was a factor in their sensitivity, we injected Ayerst brand of "Anterior Pituitary-Like" chorionic gonadotropin in amounts of 50 and 100 International Units, diluted to 2 cc with distilled water, into each of 20 frogs over a range of five different temperatures No significant difference was observed between those injected with 50 International Units and those injected with 100 International Units The results are shown in Table III

At temperatures below 60° F considerable difficulty was encountered in getting the frogs to urinate within an hour's time From these data it appears that the optimum temperature is around 67° F This experiment was carried out in August, 1949, and at this time of the year, even with optimum temperature, some frogs remained negative after injections of a large amount of gonadotropins The data also suggest that an increased length of time after injections is necessary before emission of spermatozoa by leopard frogs standing in temperatures above 75° F

Another experiment indicated that an additional factor in their susceptibility to gonadotropins is the temperature at which the frogs have been stored Frogs from one shipment in May, 1950, were divided into two groups One group was stored in a refrigerator (about 45° F) and the other at room temperature (about 74° F) Both groups were in one inch of water

TABLE IV

COMPARISON OF THE EFFECTS OF GONADOTROPINS ON EMISSION OF SPERMATOZOA BETWEEN FROGS STORED IN A REFRIGERATOR AND THOSE STORED AT ROOM TEMPERATURE

Number of Frogs	Kind of Storage	Number Emitting Spermatozoa
20	Refrigeration	13
20	Room Temperature	1

TABLE V

COMPARISON OF THE EFFECTS OF DISTILLED WATER ON EMISSION OF SPERMATOZOA BETWEEN FROGS STORED IN A REFRIGERATOR AND THOSE STORED AT ROOM TEMPERATURE

Number of Frogs	Kind of Storage	Number Emitting Spermatozoa
30	Refrigerated	16
30	Room Temperature	4

TABLE VI

COMPARISON OF THE EFFECTS OF DISTILLED WATER AND PREGNANCY URINE ON SPERMATOZOA EMISSION OF FROGS STORED IN DRY REFRIGERATION

Number of Frogs	Injected With	Number Emitting Spermatozoa
4	13 cc of distilled water	3
5	4 cc of pregnancy urine	0

They were all injected with 1 cc of Ringer's solution containing 5 International Units of Ayerst Brand of Chorionic Gonadotropin ("APL") The Summary is found in Table IV

It appears from this experiment that refrigerated frogs are much more sensitive to gonadotropins It also appears that 5 International Units is close to the minimal dosage of gonadotropin necessary to cause emission of spermatozoa in May frogs

In a similar experiment 12 cc of distilled water was substituted for gonadotropins The results are shown in Table V

From these two experiments on the temperature of storage it appears that refrigerated frogs are better test subjects but consequently more susceptible to over-injections

In a preliminary experiment 10 frogs were refrigerated (in an aquarium) without water and the effects of injections of distilled water and pregnancy urine on emission of spermatozoa were compared The gonadotropic potency of the pregnancy urine used was tested on five frogs stored in a refrigerator in one inch of water and all five emitted spermatozoa A preliminary test gave the results shown in Table VI

Although the number of animals used in this experiment is small the results seem to indicate that dry frogs are not good test animals They are not only less sensitive to gonadotropins but are more sensitive to distilled water

CONCLUSIONS

From the foregoing experiments we suggest the following ways of improving the accuracy when using *Rana pipiens* as a test animal in clinical diagnosis of pregnancy

1 Do not use more than 5 cc of fluid if possible in a single injection Quantities of distilled water and very dilute solutions have caused some emission of spermatozoa
2 Always use a salinity as near to normal (Ringer's solution) as possible Non-pregnancy urines and cold Ringer's solution showed little danger of false positives even when quantities of 10 cc were injected
3 Avoid large quantities of fluids in autumn, winter and early spring especially The frogs are more sensitive to excessive quantities in these seasons than in summer
4 Avoid excessive drying of test animals before using Frogs that stood at room temperatures until they had lost about 35 per cent of their weight by drying were then placed in water for four hours, after which some emitted spermatozoa
5 Store frogs in shallow water and in refrigeration if possible Such frogs are more sensitive to gonadotropins than those stored at room temperatures
6 Run tests at 60° F to 75° F if possible The reactiveness of the frogs decreases at temperatures above and below this range
7 By concentrating and extracting the hormones from the urine greater accuracy may be obtained without injecting large quantities into the frog

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LEADERSHIP IN LOMA A PRELIMINARY RESEARCH REPORT[1]

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"Loma," "Justino" County, Southwest, is a relatively isolated community of some 200 people, most of them Spanish-speaking, the rest of them "Anglos," that is, non-Spanish, English-speaking "Whites" From an earlier paper on culture change in Loma,[2] the Spanish culture of that community appeared to be changing in the direction of the surrounding Anglo culture, with a concomitant loss of original characteristics The topic of the present paper, leadership, suggests the adoption of an explicitly diachronic view the "new," Anglo-influenced Loma system is contrasted with the "old," almost purely Spanish one

At this stage of investigation, fifteen leadership types have tentatively been established Eight of them function within the "old," and seven within the "new" system "Old" types are the religious leader, the community leader, the man of knowledge and wisdom, the *patrón*, the *médico*, the *curandera*, the *hechicero* (*brujo*), and the prostitute, "new" types are the contractor, the creditor, the priest, the physician, the nurse, the leader in education, and the community planner Some of the old-type leaders, of course, have left traces in the present set-up

The *religious leader* is well exemplified by Sigismundo Campa Some of his leadership characteristics include his organizing role in home services, his instrumentality in the building of the church (after which home services practically ceased), his influential functioning as a member and official of various religious organizations, and his wife's catechism teaching His leadership activity is thus the development or articulation of a certain institution, religion, whereby in some respects, one of which has been mentioned, his influence is enhanced through his wife's sharing it His wife, however, is here conceived by the Lomans merely as a person to whom some of her husband's leadership has been delegated The religious leader does not occupy an "office" of leadership there is, in Loma, no such office or position called "religious leader" It is rather the personality of this particular individual which makes certain activities within the institution of religion, leadership activities As to the question whether the religious leader "belongs" to the old or the new Loma, it should be noted that an individual's seizure of available institutional opportunities for leadership is, by itself, no more characteristic of the old than of the new system What does characterize the old system is the fact that the institution chosen is that of religion Other types of leaders use other institutions, which are more characteristic of the new system

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[1] Field work in Loma was done in 1942 and 1944, in 1944, on a Social Science Research Council fellowship Writing up was begun in 1948 and continued in 1949, under grants from The Viking Fund, Inc , and the Graduate School, The Ohio State University In the summer of 1947, a graduate student spent several weeks in Loma under the joint direction of Dr John W Bennett and myself (all of Ohio State University) material collected by this student is part of the sources utilized here To these organizations and persons I gratefully acknowledge my indebtedness My special thanks go to Richard T Morris and Melvin Seeman for most helpful discussions, and to the field worker just mentioned (who for the sake of Loma s anonymity must unfortunately remain unidentified) for stimulating correspondence, regarding a first draft of the present paper

[2] Kurt H Wolff "Culture Change in Loma A Preliminary Research Report, ' *The Ohio Journal of Science*, 50 53-59, March, 1950 See this paper, also, for a description of the Loma Institute and the Justino Plan referred to several times in the present study

The *community leader* is similar for he, too, is without office and develops existing institutions He differs, however, not only because the area within which he exercises influence is not religion, but also because it is a variety of institutions, rather than one or two closely related ones In the example at hand, Alejandro Maes, these institutions are education, economics, and justice Maes gave the land on which the first school house was built, and for many years he was a member of the school board For some time in the past, he was considered the best farmer, organized co-operative work at the seasonal times it was carried on by tradition, and took a lead in the administration of irrigation For many years he was the justice of the peace Yet although school board member, water commissioner, and justice of the peace are well-defined offices in Loma, Alejandro is a leader not because he occupies these offices, but, once more as in the case of Sigismundo Campa, because of his personality, particularly because of his Loma-wide interest In fact, he probably occupies office because of his leadership, which endows his official actions with an importance that other office holders do not derive from their mere occupancy

The same individual also is the *man of knowledge and wisdom*, a designation which refers to no office whatever, for the only related existing position is that of teacher, which has, however, always been filled by a woman The area in which Maes exercises leadership in his capacity of man of knowledge includes that in which he acts as a community leader but it is broader than economics, education and justice, since it includes many other, miscellaneous matters His influence here consists in imparting knowledge and wisdom and in inspiring confidence and security through such communication Nor does he carry on or articulate existing institutions, he rather perpetuates the whole perspective and orienting character of tradition

In the cases of all three of these leaders, acts by others that are similar to those committed by them may be observed by the outsider, and may be classified as leadership acts But they are not so defined by the Lomans religious, community, and knowledge leaderships are given only to Campa and Maes, respectively

The *patrón* represents a type different from those thus far considered Not only is his office clearly established, but it also is of such a nature that it gives physical power to whomever holds it Unfortunately very little else is as certainly known about the office of *patrón* and of its characteristics as is this For instance, it is not sure whether the *patrón* merely was the largest landholder who had hired men or tenants working for him, or whether he was a full-fledged feudal baron, on however modest a scale In either case, because of the office he occupies, he exerts economic power Adriano Orlando Maes, at any rate, the only-known (perhaps the only) *patrón* Loma ever had, Alejandro Maes' father was a leader in many other respects as well Several among these leadership spheres were probably not included in the definition of his office but were due, as in the cases of the leaders thus far described, to his personality Adriano seems to have played a role similar to that of his son inasmuch as he, in his day was an over-all leader in an even more extensive sense than that in which Alejandro is or was he preceded Sigismundo Campa in religious affairs, he had the welfare of the community at heart (for instance, he donated the land for the cemetery and in fact made and planted the first cross), he had influence in matters of education, health, various customs, and, of course, in economics, and he was generally the man of knowledge and wisdom In the course of economic change, the office of *patrón* itself has disappeared, and the leadership associated with it by its particular occupant has been transmitted to other personalities, as has in part already been seen It is safe to assume that in becoming plural, the leaderships also have become specialized, but not to the point of institutionalization in offices It is true that now there are the offices of teacher, county agent (agricultural-economic), priest, physician, and more, but these have not developed historically from the *patrón*, but are all of them imported

Because of the power connected with the office of *patrón*, its occupant has a position of leadership irrespective of personality The *patrón* may therefore be called an "office leader," and his office may be said to give its occupant "office leadership" The following three leadership types that are characteristic of the old Loma system have certain similarities with that of the *patrón* It is not clear, however, whether *médico*, *curandera*, and *hechicero* (*brujo*) are leaders merely by virtue of their respective offices, or whether anybody who exercises their respective functions and thus articulates the institutions of health and witchcraft, respectively, thereby becomes a leader It is not clear, in other words, whether healing and witchcraft are offices, units in the institutions of health and, say, the sacred or magic, or whether they themselves are institutions At any rate, in the case of the first two, it is not power, and in the case of the *hechicero* it is not physical or secular but sacred power, which makes them leaders The *médico* performs the function of physician, particularly of psychosomatic physician, which, with the addition of midwife, also is the function of the *curandera* But while the patients of the *curandera* are predominantly women and children, those of the *médico* are predominantly men Both satisfy health needs, but they also have some measure of sacred power This is more clear-cut in the case of the *médico* than of the *curandera*, for the former more clearly than the latter is the counter-agent of the *hechicero* (*brujo*), the practioner of witchcraft or sorcery Witchcraft is as little a full-time occupation as is leadership in matters of religion, the community, and of general knowledge and wisdom Nor is witchcraft altogether a specialty in the sense of exclusive monopolization by the witch, for certain arts of witchcraft, particularly casting the evil eye, are exercised by a number of other individuals, men and women In a similar fashion, not all cases of bewitching require the services of the *médico* or *curandera*, often familiarity with the witch's tricks or special piety, possessed by several persons of both sexes, suffice to exorcise the spell To repeat it is difficult to decide, before the pertinent data are more carefully analyzed, whether the *hechicero* is an office leader or whether anybody who commits an act of witchcraft thereby, and for that time,[8] becomes a leader merely by virtue of his articulating the institution of witchcraft A parallel question must be entered in regard to the *médico* and the *curandera*

The *prostitute's* influence consists in the introduction to sex life and in the channelization of the evil component in human nature The former influence refers to younger boys, but the latter to mature people and, though differentially to men and women, not to men alone It is uncertain, in fact, whether Lamberta had many or even any regular customers among those whose sex life was settled, especially through marriage But her influence is nevertheless felt among fellow villagers in their treatment of her, which takes cognizance of her role and yet is friendly and respectful There are good grounds for believing that prostitution is, or rather was, an institution If this is correct, there is a further case of office or institutional leadership

In Table I, five aspects of the leadership types characteristic of the old Loman system are brought toward greater, even if still preliminary and tentative, systematization Two of these aspects, presented in the last two columns, have not been specifically discussed but will be understandable from the discussion given It should be observed that in the case of the *patrón*, the office, rather than Antonio Orlando Maes' occupancy, has been analyzed It will further be noted that a concept so often discussed in connection with leadership, that of status, has not specifically been treated here By implication, however, a certain aspect of it can easily be inferred from the fourth column of Table I this column in effect says that within the area described in it, the respective leader has the highest status, although other individuals may exercise influence within the same area Thus, in the area of religion, the religious leader has the highest status, but other persons may, and in fact do, have religious influence as well—as is true, for instance, not only of particularly religious individuals but also of such more institutionally defined persons as the officials of religious organizations, but these are not considered leaders The peculiarity of the first three leaderships, as has been stated, is that their respective areas are defined by the Lomans in terms of the leaders' personalities "Highest status," therefore, here is synonymous with "only status," inasmuch as no other person has status at all Comparable ramifications could be

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[8] "Leadership," of course does not imply continuous leadership action but only recognized availability (of person or office) for such action

TABLE I

ASPECTS OF LEADERSHIP IN THE OLD SOCIO-CULTURAL SYSTEM OF LOMA

LEADERSHIP	RELATION TO INSTITUTION(S)	PERSONAL, OFFICE, AND INSTITUTIONAL ASPECTS	AREA OF INFLUENCE	MEANS OF INFULENCE	ETHICAL ASPECT
Religious	Articulating available institution(s) (religion, church)	Personal	Religion	Precept and interpretation	Good
Community	Articulating available institutions (economics education justice)	Personal	Community affairs	Precept and advice	Good
Knowledge and Wisdom	Perpetuating perceptive and orienting aspects of tradition	Personal	Knowledge and wisdom	Advice	Good
Patrón	Fixing power distribution	Office	Power	Physical power	Neutral
Médico	Articulating institution of health	Office or Institutional	Men s health	Superior knowledge and sacred power	Good
Curandera	Same	Same	Women s and children s health	Same	Same
Hechicero	Articulating institution of witchcraft	Same	Magic	Sacred power	Bad
Prostitute	Channelizing aspects of sex and of evil	Institutional	Sex and ethics and morals	Potential and actual physical contact	Compensated, choice of the relatively better for the relatively worse

formulated in regard to the other areas of influence At any rate status refers to a leader within a given area not to leadership[4]

Before presenting new system leaderships several questions must be discussed One concerns a definition of leadership itself it refers to the exercises of significant influence within a socio cultural system—Loma is conceived as such a system If the leadership types discussed are inspected it appears that significant influence refers to one which affects the system itself—corroborating it by confirmation or articulation questioning it or changing it (In the present case there are instances only of corroborating influence The system has changed not because of leadership but because of other reasons as was indicated especially in the paper on culture change referred to in note 2 above) Leadership thus must not be confused with other influences within a system which of course are innumerable In the first place in addition to affecting the system it must also be concentrated rather than diffused It may be concentrated in an office or institution or in a person instances of all of which are found in Loma But farmers fathers mothers etc exert influences and thereby affect the system—in Loma once more in the corroborating sense They are not considered leaders because their influences are not concentrated Thus one connotation of the fact that prostitution is breaking down as an institution is the diffusion of the occupant s influence a phenomenon that is widely observed in contemporary urban cultures also

In the second place there is no leadership office alone Suppose the office of *patrón* is vacant In such a case leadership by mere occupancy has been replaced by an impersonal portion of the socio cultural system the distribution of power and land (and concomitant customs beliefs etc) It may be added that since this particular portion of the system involves power it will after a relatively short time either be personalized (by occupancy) or abolished (by some socio economic change) But by itself it constitutes no leadership although it does even without the occupant s co operation bestow it upon him Thus leadership is seen to have a further requirement namely that it be exercised by an individual[5] Moreover the leader must be a living individual If for instance a person says Christ is my leader he may actually have no leader whatever (if he should really live by nothing then Christian doctrine which is extremely improbable) but is talking about a value system or a religious conviction in short about his culture or else he actually has other leaders such as his wife or a teacher or a minister With his death Christ ceased to be a leader He was later replaced by the church an institution with many offices and office leaderships in numerous socio cultural systems other than itself among them in Loma (though in a more articulate even if weaker fashion only in its new phase)

How does the student of a system know—it may be asked—what leadership positions meet the requirements developed? Obviously he must have a certain knowledge of the system itself before he can even develop hypotheses regarding the concentration of influences that act upon it Space permits no more than a few rather apodictic remarks which are however necessary to further the argument[6] The student identifies himself as best he can with the system he is studying He will thus eventually get some sort of picture which has elements existing on the part of the participants in the system, and others existing on the part of the student The presentation itself of the picture he has gained amounts to its translation into his and his readers' culture No Lomian, for instance, would ever dream of thinking up Table I, nor can he understand it, unless he is familiar with anthropological or sociological thought But in that case his culture would have been enriched or replaced by another precisely, by the current social-science universe of discourse[7]

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[4] In the latter case status could only denote the position of a particular leadership within an order of leaderships This usage is not employed in the present paper although some of the following discussion might suggest it Furthermore no more refined analysis of the leader s status has been undertaken such as would be entailed by a differentiation of statuses into subjective objective specific general (all to be defined) or what other subdivisions might seem desirable The reason for this failure is not skepticism concerning the utility of such subdivisions but once more the present stage of analyzing the data Toward the end of this paper however (n 10 and text preceding it) a scheme will be presented which suggests a certain classification of leader statuses

[5] There is no reason why it could not be exercised by a group a clique perhaps but no such instance was found in Loma

In the "new" Loma system, the leaderships—to repeat--are contractor, creditor, priest, physician, nurse, leader in education, and community planner They can be discussed much more briefly, in part because they are more similar to one another than are the "old" types, in part because they are well known to the readers of this paper With the exception of the last two, they are office leaderships The *contractor* (Patricio Campa a nephew of Sigismundo the "old" religious leader) and the *creditor* (the Anglo trader) have taken over most of the economic functions, and thus of the power, that once were part of the *patrón's* leadership The *priest* (an Anglo) has to a considerable extent replaced the religious leader the *physician* the *médico*, and the *nurse*, the *curandera* But Sigismundo Campa still plays some role, and the officials of the religious organizations combine minor office leadership with reminiscences both on their own part and on the part of those with whom they interact, of a less institutionalized more spontaneous and personal religious life Neither have the old-time representatives of health and un-health completely died out some old people still resort to traditional medicines and cures, with or without the help of *médico* or *curandera*, believe in witchcraft, especially the evil eye, and take prophylactic and therapeutic measures against it, although a *hechicero* has not been known in the community for a long time

The *leader in education* is represented predominantly by the public-school teacher, but also by government officials (such as the county agent) whose efforts, on the whole consist in using educational measures for bridging the gap between the old and the new systems During the existence of the Loma Institute, some of its staff members, especially the president and his wife, exercised a tenuous and short-lived personal leadership, largely if not wholly irrespective of either the institution of education or of the newly created Institute itself While there is educational leadership due to the permanent existence of school and various governmental agencies, there was *community planning* only during the existence of the Loma Institute and the Justino Plan, and here again, the leadership was exercised by the Institute's president and his immediate staff He took it over from the Plan with its seat in Justino, exercised it locally, and had begun to delegate some of it to certain villagers With the demise of the two organizations, however, the function of community planning itself died out, too

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[6] Cf Kurt H Wolff, "A Methodological Note on the Empirical Establishment of Culture Patterns *American Sociological Review* 10 176-184 April 1945

[7] The old system leadership presented can be contrasted not only with that of the new system, but also with systems outside of Loma The most fruitful manner of undertaking such a more general comparison would probably be to refine the dimensions described in the columns of Table I in order to make them more clearly defined this almost certainly would involve revisions and additions Once some such improvement is achieved, however (and it is hoped that the further analysis of the Loma materials itself will contribute toward it), a usable typology of leaderships may be looked forward to Yet the variables and their articulations as suggested in Table I are so numerous that from the standpoint of economy a more advisable procedure might be to begin rather with a typology of socio-cultural systems For in this manner the multidimensionality of the leadership typology might be reduced in consideration of empirical requirements The possibility of socio-cultural systems without leadership (in the specific sense defined) should not be overlooked in such an undertaking

If this is correct, why should these processes have occurred? This question suggests a further analysis of the relation between leadership and the socio-cultural system, Loma The system, it has been shown over and over, has been changing to the extent of imposing upon its student the distinction between an old and a new phase Yet despite the fact (documented in the paper on culture change referred to before) that the contemporary Spanish culture of Loma—at least of the younger generation—is indeed a mixture of Spanish and Anglo elements, leadership in the old system strikes one as somehow more effective than in the new One suspects something that is common to all the old-system leadership types, in spite of the differences among them that have been pointed out, and conversely, one suspects something common to all the new types This common feature may tentatively be stated as the fact, in the old system, that the relation to the leader is an "end" relation, because leadership, whether of office or of person, is the implementation of an unquestioned common-value system And it is the contrasting fact, in the new system, that the relation to the leader is a "means" relation, not because leadership is in conflict with (or irrelevant to) a value system which would correspond to the new system, but because there is no unquestioned common-value system that is developed to a point where it could be implemented by leadership The personal leaderships in religion, the community, and knowledge were accorded their representatives because the practice and promotion of religious tenets and rituals, the solution of community problems or of individuals' problems that bore on the community's welfare, and the dispensation of knowledge and wisdom through personally skillful resort to tradition were values in Loman culture, ends sought for their own sake It was good to be pious, to have questions answered that referred to one's own welfare in its relation to that of the community, as well as to many other matters concerning which knowledge or wisdom were deemed good It was good to be or to serve the *patrón*—merely to resent him as an oppressive power would not have made for stability [8] It was good that there should have been a *médico* and a *curandera*, for both helped restore health, and even though they were used as means to attain this end, their occasional failure showed that they were not human means but God's instruments for showing his will, and thus they had to be dealt with as ends in themselves It is likely that the sacred power attributed to witchcraft and to the *hechicero* permits the application of a similar dialectic by which he, too, is seen to have become an end, but the precise process in which this might have been brought about is not known, at least not at this stage of analysis Finally, although it was bad that man should have an evil component which shows itself especially in his sex appetite, it was good that there should have been a prostitute, for this institution controlled the appetite, and the person who performed this function therefore imposed respect

There are some further implications of the old leadership type which must be brought out before it is contrasted with the new One is that the old leader had to make little use of coercive power The other is that the possibility of maintaining end relations with the leader was facilitated by the smallness of the community This also provides the opportunity for "over-all" relations with him people knew the religious leader, the community leader, the man of knowledge, even the *patrón* and the prostitute, not only in these capacities (in fact it was mentioned that the second and third leaderships were lodged in the same individual) but in many others as well, they knew them as fellow citizens generally The concomitance of over-all and end relation does not apply so clearly to the *médico*, the *curandera*, and the *hechicero*, because their specializations usually were too expensive for one community to support It is probable, therefore, that end relations were maintained with them in several communities, while over-all relations developed in only one of them, in their place of residence

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[8] This statement illustrates (rather than contradicts) the ethical characterization, "neutral, of the *patrón* office, as given in Table I The office itself is neutral, but may be defined in a given culture as good or bad according to whether it is accepted or resented It can be accepted (rather than merely accommodated to for a time) only if it is incorporated as a value in the culture that is presumably, in a certain number of certain individuals

A third point concerns political leaders It will be noted that they are listed neither in the old nor in the new system Yet *políticos* have been known to individual Lomans since long before the old system began to change In spite of this familiarity with the type, the politician seems never to have played any leadership role, especially perhaps because there has never been a local *político* The *político* is defined as an individual who plays politics on the side, as a part-time specialist He throws dances and hands out liquor and is paid for it by the political machine But he is not a boss, and no trace of bossism has been found that would have reached into Loma, much less have centered there He can be called a leader only if the area within which he so functions is clearly understood not to be connected with the common-value system, although the common values apply to the treatment of the politician as a person as they do to that of all others, leaders or no The politician, along with the *patrón* and the religious leader, tied (however tenuously) Loma to the outside Spanish world which was governed by politics and by comparatively far-flung economic, power, and religious relations How little politics is part of the common-value system is shown by the fact that even one of the most specifically political acts, casting the ballot is not governed by it but by other values, especially by family and similar traditions [9]

Behavior of this sort has been labeled "individualism," but this is a misnomer For it is governed, not by more or less self-relying decisions but by common, though not by political values Nevertheless, there is individualism in Loma, that is, behavior on personal rather than on common premises Individualism governs personal relations where these are not governed by the common values—religious, familial, communal, etc It does not govern relations when these have the capacity of maintaining the social order The order is accepted, which is as much as to say, a value is valued The individual as such is appraised and esteemed or not, according to the appraiser's own value system Mr McIntire, the trader, is not highly esteemed, but he is often chosen as one of the water officials, because both the regulation of the water and harmony with the creditor are valuable, and also because Mr McIntire has proved satisfactory in the office of ditch boss or water commissioner Lomans thus distinguish various roles of the same person Office roles are defined, and a given individual, if the system makes him a candidate for a certain office, achieves it by rules that themselves are part of the system Office roles are probably more numerous than are personal roles These, in turn, are considerably less clearly defined, and their attainment depends much less on the system, since this system here only limits the range of individual achievement on the part of both role player and participant or participants in the relation to which the role is relevant

All this is pertinent to leadership not only in the old, but also in the new system The most general statement that can be made about the new order is that all of the characteristics of the old are either absent or in a state of confusion That there is no common-value system that is implemented in leadership types has been anticipated There are no leaders, in other words, to whom relations constitute ends rather than means It may be added that the relatively neat distinction between office roles and personal roles, with their differential ascription and achievement and their relations to common and personal value systems, has disappeared, because the cohesive principle of the old society and culture, a common-value system, has been succeeded by another principle, the desire to overcome insecurity or impotence and to gain security or power. But since this is not a cohesive principle, it can not function as the old one did.

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[9] Thus one of the women who were most in sympathy with the Institute's viewpoint who was most interested in national affairs who, in fact had assumed some leadership in putting over communal, educational, and health plans originated by the Loma Institute and Justino Plan, and who had consistently expressed her agreement with the New Deal and with President Roosevelt, voted the straight Republican ticket because her nephew ran for county office

The contractor and the public-school teacher (as well as sometimes a doctor or a nurse) are the only Spanish leaders characteristic of the new system. For this reason they are less mere means than are the remaining leaders, all of whom are Anglos and, with the exception of the creditor and the Institute president while he was functioning, non-residents. It is understandable, therefore, that the relations with the contractor and the teacher should be less specialized and more over-all than are those with the other types. And although the office and personal roles of Patricio Campa, the contractor, and corresponding relations to him can be clearly distinguished from one another, his office itself has not gained the dignity of the older offices. The contractor does not implement a value, he provides a job. On the other hand, Filiberta Tejada, the teacher, is merely a specialist who otherwise is a Loman woman. Attitudes toward her as a specialist vary with the conception of education itself as something uninspiring that has come to be taken for granted or as an imported imposition of doubtful merit or as a prestige-giving acquisition. In no event is it a common value which the teacher would implement.

Relations with the remaining types are predominantly office relations, though not exclusively. To the extent that they are, they are specialized rather than over-all. The purest exemplification of a "means" relation is that with Mr. McIntire. Although differing from individual to individual, it is characterized both on the part of the Spanish people and on his own by bargaining. It is perhaps because of the area within which this relation obtains, economics, that it shows the new type of leadership in such purity, for it is harder to reduce the relation with and of the priest, the physician, and the nurse, to pure bargaining. The priest's office has all the dignity required to implement a common value, but here it is the occupant who falls short of his office. Yet it must be observed that already the priest's is no longer only an office leadership, since the office itself has lost significance. Church attendance is an indication of this, as are statements made both by the priest and by numerous Lomans of both sexes and various ages. Religion is no more a common value for all Lomans. Those who participate least in the old system (a group which to a considerable extent, but not entirely, is composed of the younger men) find religion least satisfying and are either confused or motivated individually by a quest for economic security or power.

The physician and the nurse are used, if at all, as means to attain the specific ends for which their respective offices equip them (though not with the bargaining characteristics of the creditor relation), or are received or resorted to with diffidence and suspicion as foreign importations (somewhat less so in case they are Spanish), or are treated as if they were *médicos* or *curanderas*. The relations to them thus are either specialized or confused. And finally, what influence the short-lived educator and community planner from the Loma Institute had was based on personal relations rather than on the establishment of common values and on participation in them. What, if anything, he had created in the way of offices thus disappeared with the removal of his person.

Before coming to a conclusion regarding leadership in Loma and implications for our own society, it may be clarifying to summarize the characteristics of leadership discussed in reference to Loma, but presumably applicable generally.

(1) Definition of leadership: the exercise of influence within a socio-cultural system, which influence (a) affects (corroborates, questions, changes) the system, (b) is concentrated in an office (institution) or person(s), rather than being diffused, and (c) is exercised by a person (or by persons) living within (or possibly outside) the socio-cultural system at the time the system is a going concern.

(2) The type of leadership is determined by its (a) relations to an institution or institutions within (or outside) the system, (b) being office (institutional), or personal leadership, (c) its area of influence, (d) its means of influence, (e) its ethical aspect or aspects, whereby (c) through (e) must be analyzed as office and personal characteristics in accordance with the information required under (b)

(3) The type of leader himself is determined by (a) the relations obtaining between him and other, differential individuals and groups, whereby end and means relations, over-all and specialized relations, and social and personal relations must be distinguished, (b) the roles played by him, which may be office roles or personal roles, (c) his status which, by definition, is the highest (or only) one within a given area (or areas) of influence and which may be analyzed further (a step not taken in the present paper) in regard to subjective status (the leader's definition of his status), accorded status (the status given the leader by differential individuals and groups), and system status (the status accorded the leader by the student of the socio-cultural system in which the leader functions, on the basis of the student's construction and presentation of this system), (d) the way in which the leader attains leadership, for which knowledge of (a), (b), and (c) is pertinent, particularly in regard to the application of ascription and achievement to (a), (b), and (c) and their subdivisions [10]

Table I sketched (2) (a) through (e) for all leadership types of the old Loma system Subsequent discussion, set by (1), arrived at (1) (a), (b), and (c), and discussion transitional to a presentation of leadership in the new system and this discussion itself yielded (3) (a) through (d) and subdivisions, though without tabulation and even without analysis of all points Yet a further aspect of leadership has been touched upon at length but does not appear in the above schema because it is not yet clear even to the point where it could be incorporated there This aspect is the relation between the system of common values (as a part of culture, which in turn is part of the socio-cultural system) and leadership All that can be done at the present stage concerning this apsect is to clarify its theoretical and methodological status

(1) To grasp the relation between a "common-value system" and leadership is extremely important for an understanding of (a) culture change, (b) the failure or success of change measures introduced into a system, and (c) the stability or instability of a system

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[10] The following schema is an abridgement of the last three paragraphs
(1) Leadership defined as influence in a socio cultural system which
(a) affects system,
(b) is concentrated (office person),
(c) is exercised by living person(s),
(2) Leadership type determined by
(a) institutional relations,
(b) office- or personal nature,
(c) influence area
(d) influence means } to be analyzed as office and personal characteristics,
(e) ethical aspect
(3) Leader type determined by
(a) relation
1 end, means,
2 over-all, specialized
3 social, personal,
(b) role
1 office,
2 personal,
(c) status
1 subjective,
2 accorded,
3 system,
(d) attainment manner

(2) The relation between the "common-value system" and leadership is not clear beyond the observation of cases in which the latter seems, and does not seem, to "implement" the former, nor is the connection between "end relations" and "common-value system" obvious beyond the suggestion that both seem to "go together"

(3) The relation between the "common-value system" and "culture" is not clear beyond the suggestions, (a) that the former is the "most important part" of the latter, and (b) that it may be absent from it, nor is the connection between "common-value system," "area" (of influence), and "culture" evident

(4) "Stability" and "instability" of a culture need definitions which must be undertaken in conjunction with efforts to define the relations between "culture," "common-value system," and "area," because it is hoped that such a combined attack may lead to satisfying the quest for understanding indicated under (1) above

This quest has been at least one of the motives for studying Loma in general, and its aspects, among them leadership in particular The idea has been and still is, that once a unique culture is grasped—and the culture of Loma, like any culture, is conceived as a unique- an understanding of other uniques including our own culture, will be furthered[11] For, it is hoped that generalizations will emerge from such a procedure which are more tenable than are those derived from viewing Loma as a mere variant of our own set-up- a view that is based on the notion that people are "generally" alike no matter where they are And it will have been noted that throughout the last portions of this paper, and particularly in some passages such as in the descriptions of religious change and of voting behavior, problems have been discussed which can be seen, even at this stage in the analysis of the Loma materials, to be our own More specifically one of the most important problems which not only Loma and we but the major part of the world have been and are facing is how to create a common-value system (whatever the definition of this term) which can implement types of leadership Closely related to this problem is the question of how long a socio-cultural system can exist without doing more about this problem than asking how it might be solved[12]

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[11] Cf Kurt H Wolff 'The Unique and the General Toward a Philosophy of Sociology' *Philosophy of Science*, 15 192-210 July 1948

[12] A further methodological theoretical note may be in order If this paper makes any contribution to the study of leadership it is through whatever theoretical suggestiveness it may possess rather than through the rigorous application of a fully developed theory to empirical materials (for many Loma materials have not yet been analyzed) or through methodological stimulation (hardly any methodology has been indicated) The following comments are offered to show a partial awareness of these shortcomings The paper is descriptive rather than explanatory or analytical To mention only two of the many "why questions neither raised nor answered Why was no 'common value system' the outcome of such concerted efforts as were made by the Loma Institute and the Justino Plan? Why did the *patrón* s son become a leader? Or analytically is there such a thing as inheritance of leadership? Is there "conversion of leadership from one area to another? And most concepts in addition to those discussed in the last pages require further clarification and interrelation also

BIOLOGY OF GASTROPHYSA CYANEA MELSH

(COLEOPTERA CHRYSOMELIDAF)

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One of the earliest insects to resume activity in the spring is a bright metallic blue or green leaf beetle which feeds on various species of ***Rumex*** They have been observed feeding and ovipositing as early as April 3rd in the locality of Columbus, Ohio This paper presents the life history and some of the external morphological characteristics of the larvae and adults

SYSTEMATIC POSITION AND PREVIOUS WORK

This beetle is a leaf feeding member of the subfamily Chrysomelinae, family Chrysomelidae, order Coleoptera

The taxonomy of the genus is somewhat confused Leng (1920) lists the genus as ***Gastroidea*** Hope, with ***Gastrophysa*** Redt as a synonym, giving as authority the ***Coleopterists Manual***, London, III, 1845, p 164 Barber and Bridwell (1940) indicate that the genus should be known as ***Gastrophysa*** Chevrolat, as was adopted by Redtenbacher, these authors base their opinions on the third or 1837 edition of the ***Dejean Catalogue of Coleoptera***

The specific name ***cyanea*** was set up by Melsheimer in 1847 In his description the color is listed as "blue scutellum green, elytra with a green reflection," this does not appear to definitely limit the species as to color, but since the word "blue" follows immediately after the species name in the description, the species ***cyanea*** probably should be considered as blue in color A definite green form occurs in various parts of the country, however, McCracken (1906) after lengthy studies, concluded that the species contains both blue and green forms with the blue being genetically dominant Blatchley (1910) describes ***G cyanea*** as "Oblong-oval Uniform brilliant green or blue '

Leng lists a subspecies or variety, ***caesia*** Rogers, from California, which is green Goe (1918) listed his insects only as ***Gastroidea caesia***, this work was done in Oregon and he may have been working with the green form of ***G cyanea***

In this study, both blue and green forms have been used, they are considered hereafter as a single species, since there are no observed differences in habits or immature stages and none in the adults except color Crosses were not made

The previous life history work on this insect is rather sketchy Girault (1908) records "the general outline of the cycle, together with a description of the egg " The incubation period and duration of larval stages are recorded in days and hours, the food plant is listed as "a species of ***Rumex*** " Color was not mentioned The general paper by Goe (1918) contains notes on oviposition, incubation, and larval development McCracken (1906) reared many of these beetles, however, the primary interest was in color and life history records were taken only in an incidental manner

DISTRIBUTION AND ECONOMIC IMPORTANCE

This beetle appears to be generally distributed in the United States and southern Canada Leng (1920) lists ***G cyanea*** as occurring from California to Indiana, and

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[1] The writer wishes to acknowledge assistance received from the following people Prof D M DeLong Ohio State University, Prof Dwight Isley, University of Arkansas Dr M W Sanderson Illinois Natural History Survey Mr John A Wilcox, Ohio State University, and Mr Ben H Richardson formerly of Ohio State University

in Arizona and Connecticut Goe (1918) stated that it occurred abundantly in the Pacific Northwest Specimens have been collected personally in Ohio, Kansas, and Arkansas There are numerous records from Ohio

The beetles may become quite abundant in localized areas but are not found in every stand of the common *Rumex* species Around Columbus they were found most often on *R obtusifolius* but the points of infestation were rather widely separated Flight was not observed and could not be induced, indicating that the insect probably increases its range only by walking

Outside of occasional feeding on rhubarb (Essig & Hoskins, 1944) (Goe 1918), these beetles are of very little economic importance Their short period of activity and highly localized distribution prevent their being of much value as a natural control of the *Rumex* species which serve as host plants Their slight occurrence on rhubarb probably does not make necessary the use of control measures

REARING METHODS

Beetles were collected in the field and kept in Petri dishes for feeding and oviposition, fresh leaves of *Rumex obtusifolius R crispus* and *R altissimus* were supplied daily as food Adults were also caged on plants of all three species in order to observe feeding and oviposition habits

Larvae were reared in petri dishes on potted plants and on plants growing outside the insectary Second and third instar larvae ate large quantities of food As the feeding period ended the petri dishes were filled two thirds full with loosely packed soil for pupation This allowed observation of the actual pupal period within the cell

FEEDING AND OVIPOSITION HABITS

Adult Feeding

The adults usually make their first appearance on the lower surface of the leaves of the host plant The preoviposition feeding period varies in length with the average daily temperatures following spring emergence The overwintered adult females may live four to eight weeks

The beetles feed at first on small patches of the lower surface of the leaf, later they feed along the margin eating inward a short distance and progressing along the edge at the same time Individually they do not consume a great amount of food

Oviposition

Eggs normally are laid in compact groups on the lower surface of the leaves of the host plant with most masses being placed along the midrib and often near the base of the leaf If the beetles are crowded they may deposit the eggs elsewhere

The number of eggs per group averaged about 40, the maximum was more than a hundred Field collected caged females averaged 1135 eggs each, the range was from 808 to 1435

Larval Feeding

The larvae are also leaf feeders and develop rapidly when temperatures are favorable The newly hatched larvae are pale yellow with black heads, they soon become entirely black The first hatching larvae have been observed feeding on the other eggs in the group, although this does not appear to be of common occurrence There are two ecdyses between hatching and pupation, with a resting or prepupal period preceding the pupa

The larvae wander out over the under surface of the leaf almost immediately after hatching, settle in compact groups, and eat small holes in the lower layer of the leaf tissue As the larvae feed, their black bodies enlarge, the thin pleural and intersegmental membranes become tightly stretched between the sclerotized plates and larvae become yellowish green in color The upper surface of the leaf may at times appear gray and translucent over the areas where the larvae have fed heavily

The caudal end is usually anchored to the leaf by the anal sucker before the molts occur The black exuvium is left upright on the lower surface of the leaf this furnishes a good check on larval molting

The second instar larvae also become black soon after molting and they tend toward individual rather than group feeding During this period these larvae spread out over the leaf and to other portions of the host plant feeding and becoming lighter in color The tissue of the leaf is destroyed leaving only the branching framework of veins this type of injury often resembles that of a skeletonizer

The second molt also occurs on the under side of the leaf and is not unlike the first The third instar larvae spread rapidly over the entire plant and to adjoining plants if they have not previously completed the movement Leaves are often stripped down to the midrib and green seed stalks are denuded in a stand of limited size a large population of this insect usually reduces each plant to a stubby brown stalk with a few ragged leaf remains

TABLE I

G cyanea DURATION OF INCUBATION PERIOD 1947

TEMPERATURE °C	INCUBATION PERIOD—DAYS			No EGGS
	Average	Maximum	Minimum	
10 0 10 9	13 64	19	12	1 180
11 0 11 9	10 28	11	10	106
12 0 12 9	13 66	14	13	233
13 0 13 9				
14 0 14 9	7 41	8	7	261
15 0 15 9	7 14	8	7	386
16 0 16 9	6 28	7	6	1 498
17 0 17 9	5 53	6	5	551
Total				4 215

The mature larvae are yellowish green and measure about half an inch in length when completely fed After only a few days of feeding the third instar larvae bury themselves in the soil usually at depths of less than half an inch here a pupal cell is formed The larva assumes a somewhat crescentis shape becomes more or less immobile and rests for several days The pupal stage occurs in this cell

Duration of Stages

The incubation period for 4215 eggs of *G cyanea* with temperatures ranging from 10° to 18° C varied from 5 to 19 days (see Table I) The average incubation period for all observed series of eggs was 9 3 days at an average temperature of 13 2° C

These eggs were deposited over a period of 6 weeks from April 16 to May 27 inclusive The great number of eggs hatching with an average incubation temperature of 10 0–10 9° was due in part at least to a cold wave which occurred during the early stages of this life history study Hatching was delayed for several days a relatively small rise in temperature then initiated the emergence of many new larvae

The duration of all pre-imaginal (egg through pupal) stages may be summarized in the following table

TABLE II

G cyanea DURATION OF PRE IMAGINAL STAGES (DAYS) 1947

	STAGE					
	Egg	1st Instar	2d Instar	3d Instar	Pre pupa	Pupa
Maximum	19	12	5	5	6	9
Minimum	5	3	3	2	2	4
Average	9 3	4 5	3 8	3 1	4 5	6 3
Totals*	4 215	1 937	1 657	1 363	960	812

*This represents total number individuals in each stage

The correlation of post embryonic pre imaginal stages with temperature is presented in Fig 1 In this graph is shown the average time of development and the average temperature during that period for all larvae hatching on a given date For instance on the chart below all larvae hatching on May 1st became adults after an average time of 30 26 days the average temperature during this period was 55 7° F

DESCRIPTION OF STAGES

The following descriptions of the stages are intended for comparative rather than taxonomic purposes the descriptions are given as a means of recognition of this Chrysomelid species and do not necessarily separate it from others in the same genus

Egg

Length 93 mm width 46 mm These are averages based on measurements of 100 eggs taken from different egg masses

Color light orange yellow liberally to sparsely speckled with minute red particles Shape elongate oval ends rounded concave convex in lateral view Surface smooth simple and sticky when deposited micropyle inconspicuous Clear area in one end when deposited this disappears as the embryo develops or increases in size when the egg is not fertile Ocelli mouthparts claws and spines show black through the chorion prior to eclosion

Larva

Larvae are dark brown to black becoming gray with approach of ecdysis body widest at about 4th abdominal segment tapering gradually cephalically and more rapidly caudally body surface finely spinose densely so in third instar moderately in 1st and 2nd body linear after hatching and each ecdysis becoming crescentic in lateral aspect after feeding with highest point over metathoracic and first abdominal segments

Head dark brown to black ovate spherical wider than deep with mouthparts directed downward epicranial and frontal sutures prominent ocelli six four slightly above and caudal of antennal fossae and two below and slightly forward antennae 3 segmented with accessory digit distally on second beside the small third segment which bears three tiny bristles apically mandibles 5 toothed palmate and cupped mola absent labium simple fleshy with W' shaped darker sclerotized area extending cephalically between and partially around the bases of the 2-segmented palpi, maxillae large and fleshy, bearing a single mala or lobe in place of galea and lacinia, mala dark, sclerotized, and bearing a row of short stout bristles on mesal surface, maxillary palpi 4-segmented, labrum present, hinged, short, wide, notched, and bearing a transverse row of setae just below the center line, clypeus short, with spines along lower margin

Thorax half or more than half as long as abdomen, mesal tubercles bear single seta, others have one or more setae, meso- and metathoracic tubercles prominent, contain eversible glands and bear two setae each, prothoracic shield present, large, with marginal row of setae cephalically and scattered setae elsewhere, spiracle large, on mesothorax, situated on forward edge of segment laterally, adjoining tubercles just above base of leg

Abdomen rounded, tapering caudally, all tubercles bearing 2 setae except dorsal on 7th segment, glands on segments 1 to 7 located in tubercles forming dorso-lateral row (3rd and most prominent row from dorso-meson) in 2nd and 3rd instars, glands are present on same segments in 1st instar but are very small and apparently not eversible, two mesal tubercles on segment 7 fused into a single large one bearing 4 setae, 8th segment with no centrally located tubercle but with 4 setae located mesally along the caudal margin, 9th segment without tubercles, but with a marginal row of setae caudally, and somewhat shield-shaped, 10th segment inconspicuous, bearing anal sucker, which contains anal opening, spiracles annular, forming lateral row on segments 1 to 8 inclusive, located just below glandular tubercles, only two rows of tubercles present between spiracles and dorso-meson in 1st instar, 3 rows present in other instars

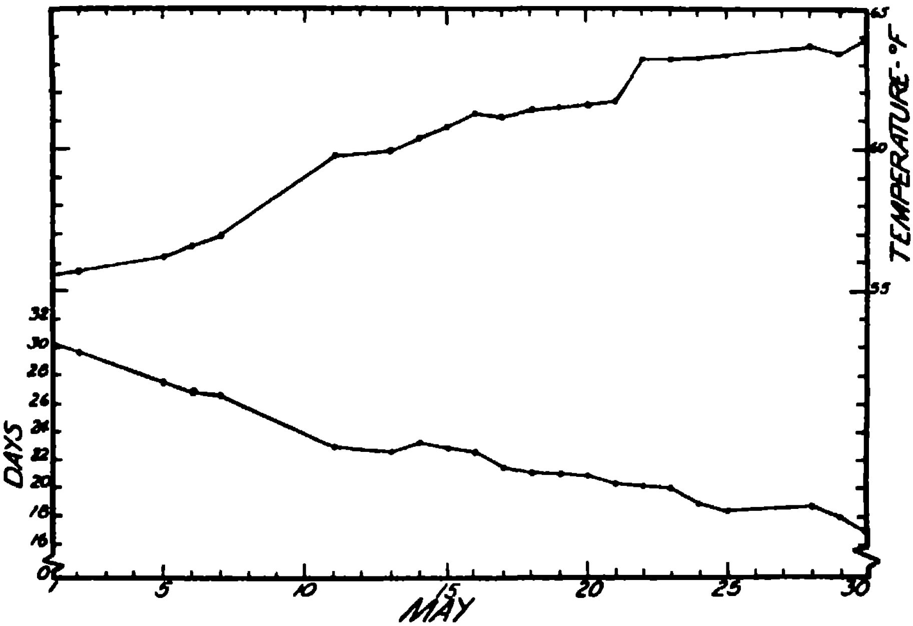


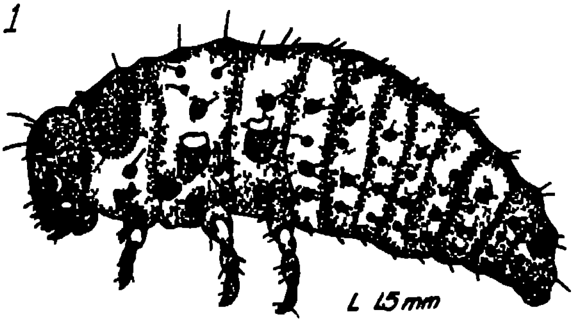
FIG 1 *G cyanea* Correlation of Stages with Temperature 1947

Legs medium in length, 5-segmented slightly elbowed at joints, coxa longest segment, broad, heavy, trochanter short, triangular laterally and open behind, femur short, thick, and shorter mesally tarsus one-segmented, ending in a single claw which is situated beside a soft pad or pulvillus

Gastrophysa cyanea
Fred A. Lawson

PLATE I

1



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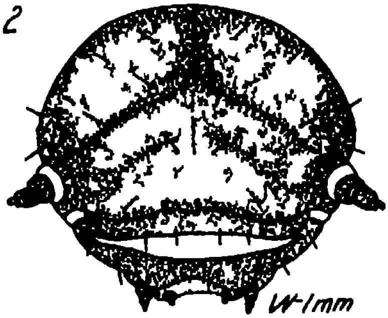

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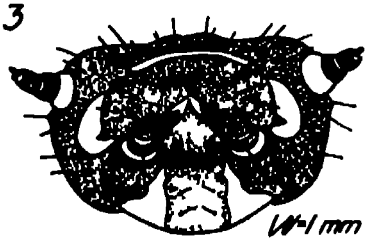

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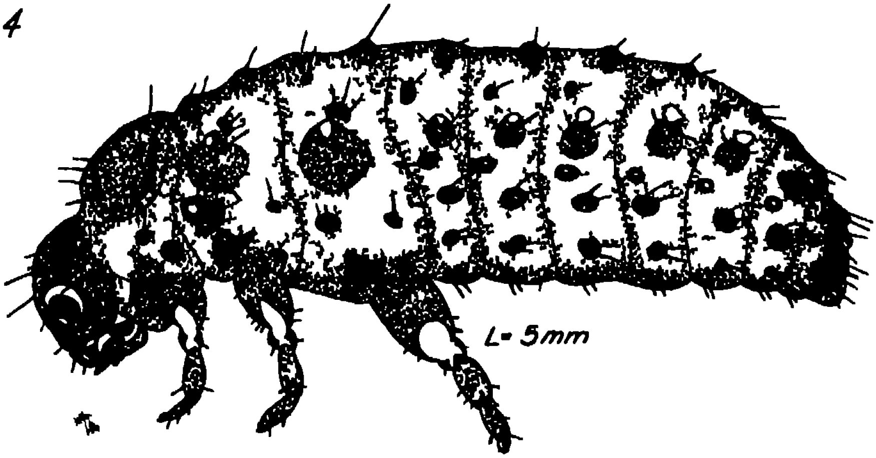
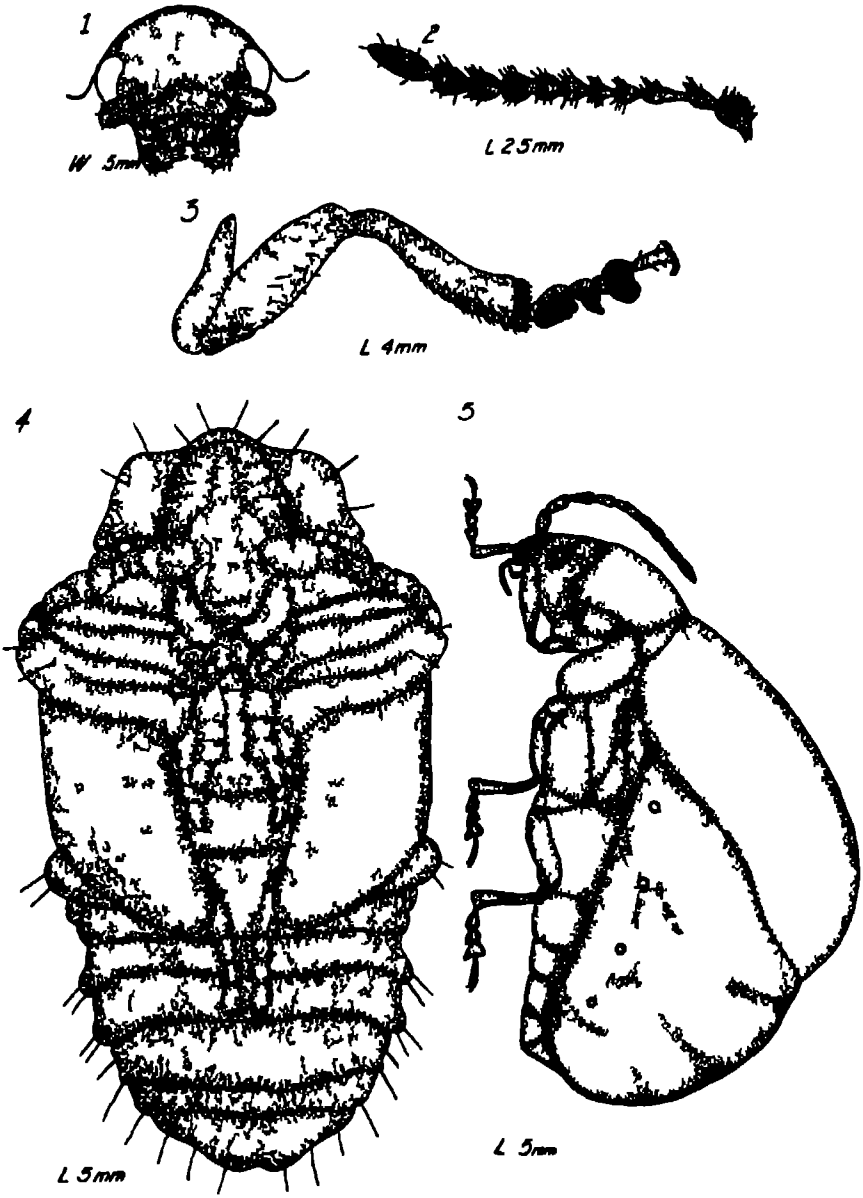


Gastrophysa cyanea M.

FIG. 1. 1st instar larva, side view. FIG. 2. Head, front view, 3rd instar larva. FIG. 3. Head, ventral view, 3d instar larva. FIG. 4. 3d instar larva, side view.



Gastrophysa cyanea M

FIG 1 Head adult front view FIG 2 Antenna of adult FIG 3 Leg of adult FIG 4 Pupa bottom view FIG 5 Female side view

Head capsules of 50 larvae of each instar were measured with an ocular scale micrometer The widths of the head capsules by instar were as follows

Instar	*Range (mm)*	*Average (mm)*	*Ratio of Increase*
1st	45– 50	47	
			63
2d	68– 87	75	
			70
3d	98 1 17	1 07	

Pupa

Pupa yellow exarate more or less curved in lateral outline appendages free movable and visible head not visible from above mouthparts directed caudally pronotum turned ventrally bearing two transverse rows of setae cephalic and caudal on the segment single setae on tubercles of thoracic segments thoracic spiracle annular on mesothorax at lateral base of pronotum abdomen with 6 rows of tubercles (in 3 pairs of rows) visible dorsally mesal pair of rows extending from 1st to 6th segments inclusive spines on each tubercle large 2 in number lateral rows on segments 2 to 8 inclusive tubercles most prominent with 2 prominent setae on each intermediate rows near to lateral rows tubercles smaller each with 2 less conspicuous setae spiracles annular visible dorsally on segments 1 to 6 inclusive spiracles on segment 6 not so heavily sclerotized and less prominent than on other segments row of spiracles situated between lateral and intermediate rows of tubercles abdominal segments 10 in number from dorsal aspect

Adult

A short description of the adult of this species is given by Blatchley (1910)

SUMMARY

The dock leaf beetle *G cyanea* Melsh is an insect which overwinters as an adult emerges very early in the spring and feeds briefly but heavily on species of *Rumex* during a single generation of growth

The abdomen of the female becomes greatly distended and she deposits many eggs Delayed oviposition on the part of different females causes all stages to be present in late May and early June

The larvae consume quantities of leaf tissue then retire to just below the surface of the soil for a brief prepupal resting period which is followed by pupation The adults which emerge from these pupae occasionally appear above ground for a brief period of feeding but in general they remain within the pupal cell

This insect is of little or no economic importance in Ohio

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OHIO ROBBER FLIES V

(DIPTERA ASILIDAE)

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The following new records and notes concerning Ohio Asilidae are herewith set forth under 6 headings (1) New Ohio records, (2) Change of name, (3) Unusual records of species not new to Ohio, (4) Zoomimesis, (5) Honeybee Prey records and (6) Literature cited

1 NEW OHIO RECORDS

Three species new to Ohio are here recorded bringing the total number of species known from Ohio to 94

91 **Ceraturgus aurulentus** Fabricius This rarest of North American Asilids was collected at a light-trap by John S Thomas in Washington Twp, Jackson County, a few years ago and is now in the collection at the Ohio State Museum The specimen was a male, but with antennae broken off No date is available This species was known as the ' long-lost *aurulentus* " Described by Fabricius in 1805 from a New York specimen, it was not subsequently taken until Dr C W Johnson collected one in 1892 at Westville, New Jersey There are only 10 specimens known in collections I have 3, one collected by Dr Josef Bequaert in Van Cortland Park New York City, without date (although probably 1919) and subsequently given to me one collected by myself at Stamford, Connecticut, on August 2, 1936, and one taken by Dr P W Fattig at Blood Mountain, Georgia, on September 17, 1939 Dr Fattig very kindly donated this specimen to me According to the Journal of the New York Entomological Society, Vol 27 page 345, 1919 (Reference from Dr Carl Parsons) another was collected by Mr Burns at Singac, New Jersey No date is available, nor is the present location of the specimen known The New Jersey State list records 2 more specimens, one from Chester and one from Trenton July 7 (Harbeck) On August 17 1925, a female was collected by W W Newcomb at Ann Arbor, Michigan, and is now in the University of Michigan Collection

92 **Stichopogon argenteus** Say This very small silvery species occurs on sand Dr Josef N Knull showed me in 1947 a specimen,collected by Professor R C Osburn in Ottawa County, August 7 (No year given) This was the first Ohio record, although it was known to occur elsewhere along the sandy shores of the Great Lakes In 1949 Dr Edward S Thomas, Curator of Natural History, Ohio State Museum, collected a series of 5 males and 14 females on the dry loose sand just back from the beach of Kelley s Island, Erie County, August 25-30 Three were taken with prey, 2 with Chironomid midges, one with a minute cricket

93 **Holcocephala fusca** Bromley (description to appear in American Museum Novitates) Taken in Texas, Tennessee and Ohio The Ohio records are as follows Beaver Pond, Adams County, August 7, 1948 (E S Thomas, J S Thomas, and S W Bromley), the following with prey 5 with *Culicoides* spp, 1 with *Phortica* sp, and one with a minute Scolytid beetle

Holcocephala fusca listed from specimens det by S W Bromley, 1949 and in the Ohio State Museum as of Nov 18 1949

Adams Co, Ohio, Aug 10 1935, Edw S Thomas—2
Adams Co Ohio, Beaver Pond, Aug 4 1937 Edw S Thomas—2
Erie Co, Ohio, Castalia, Aug 14 1939, E S Thomas—1

Erie Co Ohio Huron Twp Sept 12 1943 E S Thomas—1
Vinton Co Ohio Swan Twp July 30 1937 R M Goslin—1
Lawrence Co Ohio Aug 18 1929 J S Hine—1
Ross Co Ohio Andersonville Aug 17 1941 R M Goslin—3
Ross Co Ohio South Union Twp Aug 25 1941 R M Goslin—1
Ross Co Ohio Paint Twp Aug 16 1947 W E Goslin—2
Hocking Co Ohio Neotoma July 26 1936 E S Thomas C F Walker—1
Union Co Ohio Marysville Aug 13 1940 Clem Wolfe—1
Fairfield Co Ohio Flatrocks Aug 14 1938 R M Goslin—1
Fairfield Co Ohio Flatrocks Sept 25 1936 R M Goslin 1
Fairfield Co Ohio Berne Twp July 15 1939 R M Goslin—1
Fairfield Co Ohio Berne Twp Aug 13 1936 R M Goslin—1
Fairfield Co Ohio Berne Twp Aug 10 1936 R M Goslin—1
Fairfield Co Ohio Lancaster Aug 2 1935 R M Goslin—1
Fairfield Co Ohio Lancaster Aug 1 1936 R M Goslin—1
Fairfield Co Ohio Lancaster Aug 5 1935 R M Goslin—1
Columbus Alum Creek Aug 7 1943 R M Goslin—2
Columbus Alum Creek July 4 1944 R M Goslin—1
Columbus Alum Creek July 29 1944 R M Goslin—1
Columbus Alum Creek July 11 1943 R M Goslin—1
Columbus Alum Creek July 12 1943 R M Goslin—1
Columbus Alum Creek July 31 1943 R M Goslin—2
Columbus Alum Creek Aug 12 1947 R M Goslin—1
Columbus Alum Creek Aug 15 1943 R M Goslin—3
Columbus Alum Creek Sept 7 1942 R M Goslin 1
Columbus Alum Creek July 18 1948 R M Goslin—3

94 **Diogmites missouriensis** Bromley (Description to appear in American Museum Novitates) The first Ohio record of this species of the Missouri and Mississippi River Valleys was collected in a field in which weeds had recently been cut at the edge of a vegetable garden in a corner lot at Erie and Raymar Streets in Hyde Park on August 11 1947 by R M Goslin and S W Bromley On August 17 1949 Dr E S Thomas S W Bromley and R M Goslin went back to this place Another specimen a female (the preceding being a male) was collected by R M Goslin at the very spot where the 1947 one was found

2 Change of Name

The numbers preceding the following data are those used in my original listing

24 **Laphystia ochreifrons** Curran In my original list of Ohio Asilids in Ohio State Museum Bulletin vol 1 No 2 1931 page 8 *Laphystia notata* Bigot was recorded from Cincinnati in both the J S Hine and the Charles Dury collections This name should be changed to *Laphystia ochreifrons* Curran One of Curran s types was from Ohio *Notata* does not seem to occur east of the Mississippi

3 Unusual Records of Species Not New to Ohio

26 **Atomosia glabrata** Say Resembles superficially *A puella* Wiedemann but has more yellow on the legs the undersides of the front femora being entirely yellow It rests on leaves and plant stalks 5 specimens were collected in Jackson Twp Vinton County August 19 1941 by R M Goslin At Roseville August 13 1949 one was noted but not collected resting on the stem of a tall Joe Pye weed At Hyde Park on August 17 1949 one was collected by R M Goslin on a corn stalk Mr Goslin also saw one in the same cornfield on August 18 1949 where it was resting on a leaf-blade of corn with a white fly in its grasp Two specimens were collected by R M Goslin at Neotoma Hocking Co on August 16 1942

Atomosia glabrata Neotoma Goodhope Twp, Hocking County, Ohio, Aug 16, 1942 1, R M Goslin

Atomosia glabrata Vinton County, Ohio Jackson Twp S 25 Aug 19 1941 1, R M Goslin

Atomosia glabrata, in the Ohio State Museum Collection

Neotoma, Goodhope Twp Hocking County Ohio Aug 16, 1942, 1, R M Goslin
Vinton County Jackson Twp, Ohio S 25, Aug 19 1941 4, R M Goslin
Cincinnati, Ohio, Hyde Park, Aug 17, 1949, 1 R M Goslin

38 **Bombomima thoracica** Fabricius Dr J N Knull collected a female with a 17-year cicada as prey at Clifton, June 5, 1936 The cicada was of the smaller variety, *Magicicada septendecim* (L) var *cassinii* (Fisher) This is my only record of an asilid attacking the 17-year locust, although the dragon fly, *Epiaeschna heros* and the introduced ground beetle, *Calosoma sycophanta*, are known to prey on this cicada

40 **Dasylechia atrox** Williston Dr J N Knull, Curator of the Ohio State University Insect Collection, discovered a female of this rare species in one of the student collections in 1948 without label but presumably collected that summer on or near the Ohio State University campus Another in a student collection in 1949 was labelled Sharon, Ohio, June 7, 1949

42 **Mallophora orcina** Wiedeman **The Southern Bee-killer** This species was recorded from Madison Township, Guernsey County in late summer, 1915, by Thomas Guyton in his unpublished Master's thesis "Insects of an Ohio Farm" (O S U 1916), on p 119 of the 149 page typed manuscript This is the northernmost record of the species It was collected abundantly at Hyde Park, near Cincinnati, in 1899 by Charles Dury A series was collected by E S Thomas, R M Goslin and S W Bromley at Perry, Gallia County, in a Joe Pye weed swale on August 27, 1938, and in a sandy bean field in Harrison Township, Scioto County, on August 28, 1938 In the University collection in the Botany and Zoology Building O S U are 2 specimens collected by R W Strandtmann on August 8, 1942, in Lawrence County, and 2 more on August 9, 1942, in Jackson County

44 **Promachus hinei** Bromley New localities are Numerous specimens collected by Homer F Price of Payne, Ohio, in Paulding and Defiance Counties, between July 31 and Sept 26, where Mr Price reports the species to be common Defiance County, July 31, 1942, and Blue Creek, Paulding County, August 2, 1942, Clifton Gorge, August 13, 1948 (J N Knull and S W Bromley), Roseville, August 13, 1949 (S W Bromley) and a series collected by E S Thomas, R M Goslin, S W Bromley and Ralph Dury at Linwood and Hyde Park mostly in cornfields and surrounding rank vegetation on August 17 and 18, 1949, Ross County, Andersonville, August 17, 1941, R M Goslin, Adams County, Monroe Twp, August 14, 1938, Edward S Thomas and John S Thomas, and Adams County, Meigs Twp, August 16, 1947, Wm E Goslin

45 **Promachus rufipes** Fabricius Mr Robert M Goslin, in rearranging the exhibit collection at the Ohio State Museum found a series of this species that the late Professor J S Hine had collected in Lawrence County, August 18, 1929 There were one male and three females in the series *Rufipes* is restricted to the extreme southeastern counties in Ohio In certain parts of the "deep South," *rufipes* is called the "Bee Panther" because of its attacks on the domestic bee The most northern record of its capture is Hudson, New York, where I collected it in August, 1924

68 **Mallophora clausicella** Macquart Abundant at "Neotoma," Hocking County, on August 28, 1943, where collections were made by S W Bromley and R M Goslin They were noted flying actively about within 6 inches of the ground, alighting on Andropogon and other weed stalks One was noted preying on a halictid bee A female was noted laying a white froth-covered packet of eggs

on the tip of a grass head in a footpath A mating pair was noted In flight, these flies carried the tip of the abdomen upturned

82 **Leptogaster tenuipes** Loew A total of 14 specimens[1] of this rare Ohio species has now been collected by Robert M Goslin, 13 along Alum Creek, Columbus, and 1 in Berne Twp, Fairfield Co The dates range between July 22 and September 6

4 ZOOMIMESIS

All through the larger Diptera we find species of flies mimicking the well-defended aculeate Hymenoptera with which they are locally associated In Ohio there are several robber flies which are mimics of common native bees and wasps Here are the 12 outstanding mimics listed with the degree of mimicry exhibited and the name of the model

13 **Ceraturgus cruciatus.** Fair mimic of queen yellow jacket, *Vespa maculifrons* or *Vespa arenaria*

84 **Ceraturgus dimidiatus** Fair of queen hornet, *Vespa maculata*

91 **Ceraturgus aurulentus.** Fair of worker yellow jacket, *Vespa maculifrons* or *V arenaria*

19 **Diogmites discolor** Poor of brown wasp, *Polistes fuscatus*

40 **Dasylechia atrox** Good of carpenter bee, *Xylocopa virginica*

38 **Bombomima thoracica** Excellent of bumblebee, *Bombus impatiens* or *B vagans*

37 **Bombomima grossa** Poor of large bumblebee O E Plath considered *grossa* mimetic of the guest bumblebee *Psythirus laboriosus* Fabr

36 **Bombomima flavicollis** Good of sand bee, *Andrena carlini* Ckll

35 **Bombomima divisor** Poor of hornet, *Vespa maculata*

39 **Bombomima virginica.** Good of worker bumblebee, *Bombus impatiens*

68 **Mallophora clausicella.** Fair of bee *Megachile latimanus* Say

42 **Mallophora orcina** Fair of worker bumblebee *Bombus americanorum*

5 HONEYBEE PREY RECORDS

21 **Diogmites neoternatus** Bromley Through an oversight, this species was not listed among the asilids preying on Ohio honeybees in my last paper, Ohio Robber Flies IV, Ohio Journal of Science 67, 2, March, 1947, p 68 I have 3 Ohio records of this species with honeybee prey one, Roseville, August 3, 1941, and two, Montgomery, near Cincinnati, August 11, 1947, (S W Bromley and R M Goslin) This long-legged scraggly species, characterized by the clavate abdomen

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[1] *Leptogaster tenuipes*
In Ohio State Museum
Columbus Ohio Alum Creek—July 22 1944—2
" " " " Aug 7 1943—1
" " " " Aug 14 1943—2
" " " " Aug 19, 1942—1
" " " " Aug 22 1944 -1
" " " " July 30 1949—1
Fairfield Co Ohio, Berne Twp S 9—September 6 1943—1
Leptogaster tenuipes
In R M Goslin Collection
Columbus Ohio Alum Creek—Aug 14 1943—1
" " " " July 29, 1944—1
Leptogaster tenuipes
To Dr Stanley W Bromley Collection
Columbus Ohio Alum Creek—Aug 13 1946—1
" " " " Aug 27, 1946—1
Leptogaster tenuipes
To the Ohio State University Collection
Columbus, Ohio Alum Creek –Aug 28, 1947—1
All of the above specimens collected by Robert M Goslin

which is entirely pale reddish-yellow without black markings, and the three deep black velvety stripes on the mesonotum, the middle of which fades into red anteriorly is a ghostly appearing robber fly, flying silently with outstretched legs in a manner reminiscent of the Phantom Crane fly, *Bittacomorpha clavipes* The large dark eyes stare at one as the fly hovers nearby This *Diogmites* has the peculiar habit of flying, when disturbed, directly *through* a shrub or weed, rather than over or around it It feeds largely on bees and wasps, frequently catching honeybees and *Polistes* wasps

22 **Diogmites umbrinus** Loew **The New York Bee-Killer** This species occurs locally throughout the state but is most frequently found in the Ohio River Valley An amateur entomologist who kept bees for many years in New York State once told me that he thought this robber fly, together with the Nebraska Bee-Killer, *Promachus fitchii*, had caused economic losses to bee keepers there, and furthermore said that he believed these 2 species largely responsible for the statement made on page 142 of Howard's Insect Book, that Dr Fitch's correspondent had claimed that "it was through the work of robber flies that during certain seasons in a bee-raising region in New York not a single hive threw off a swarm " P fitchii's season was late June and July with *umbrinus* taking over in August and September I have never heard of this species causing such losses in Ohio The Nebraska Bee-killer of course has never been recorded from Ohio, which is probably due to the fact that it requires a certain type of soil, lacking here

In August, 1930 Dr Kellogg, then Professor of Bee-keeping at the Massachusetts Agricultural College, Amherst, Mass , found *D umbrinus* killing honeybees in numbers at the College Apiary In writing of this species, I am reminded of an interesting item told me by my great friend, the late C W Johnson In 1913 a colony of the wasp *Aphilanthops frigidus*, was harassed in Massachusetts by *D umbrinus* This robber fly was seen seizing not only the wasps alone but also when carrying their own prey of winged female ants

I might add that *umbrinus* once the most abundant of the larger asilids in New York and New England, has become increasingly scarce during the past 50 years It formerly occurred within the limits of New York City, Angus having collected it preying on honeybees at West Farms years ago, but now it has disappeared from most if not all of Westchester County Long before this species was scientifically described, it was pictured in Dr E Emmons' "Natural History of New York' (1854) plate 28, Fig 2 labelled "undescribed " This red robber fly was abundant in South Central Massachusetts during my boyhood and was even noted flying in the streets of Southbridge, where it was common in flower and vegetable gardens It was the first robber fly to engage my attention when I found it capturing yellow jackets near their nests, thereby endearing itself to me in my childhood fight against the common enemy

I have obtained additional Ohio honeybee prey records from the following

42 **Mallophora orcina,** 50 plus (George E Perry, Newtown) Mr Perry told me on August 18, 1949, that he had seen more than 50 bees captured by this "Bee Hawk" during the past few years They fly singly about the hives and catch the bees on the wing, sometimes close to the entrances Frequently this audacity amounts to suicide The bees, enraged by the killing of one of their number, attack the robber fly en masse and sting it to death Strong colonies of bees, according to Mr Perry, will not tolerate the presence of this fly close to the hive He has found the dead bodies of *orcina* at hive entrances on a number of occasions—mute testimony of the bees' deadly retribution

43 **Promachus vertebratus,** 22 17 near or at Columbus (SWB) plus 5 at Alum Creek, Columbus (RMG)

44 **Promachus hinei,** 18 5, Defiance and Paulding Counties (Homer F Price) 5, Roseville (SWB) 8, Cincinnati (Ralph Dury, R M Goslin, S W Bromley)

38 **Bombomima thoracica,** 14 Columbus (R M Goslin)

19 **Diogmites discolor,** 14 Columbus (R M Goslin) Cincinnati (G E Perry and McClure) (R M Goslin and S W Bromley) On August 17 1949 at Newtown Mr McClure found a large male dead at hive entrance after it had caught a bee and was mobbed and stung by the swarm

22 **Diogmites umbrinus,** 10 6 Lancaster (SWB) 4 Cincinnati (RMG and Ralph Dury)

This brings the total honeybee prey records for Ohio Bee killing Asilids to the following tabulation of the 6 outstanding bee-killers

Name of Asilid	*Number of honey bee prey*
Mallophora orcina	71
Promachus vertebratus	50
Diogmites discolor	31
Promachus hinei	26
Bombomima thoracica	23
Diogmites umbrinus	19

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CONFERENCE ON THE SCIENTIFIC METHOD

Roosevelt College and the Philosophy of Science Association will conduct a two day conference on What is the Scientific Method? at Roosevelt College in Chicago on Friday and Saturday October 20 and 21 1950 Principal speakers will be Professors Sebastian Littauer Columbia University Nicholas Rashevsky University of Chicago Howard Becker University of Wisconsin and Thomas Cowan Wayne University

For further information please write either to Professor Morris Goran Roosevelt College 430 S Michigan Avenue Chicago 5 Illinois or Professor Russell L Ackoff, Wayne University Detroit 1 Michigan

CHLADNIAN MOVEMENT IN THE WOOD OF VIOLINS

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In a program to discover the "lost art" of the old Italian violin-makers Stradivari, the Guarneri, the Amati, etc., the writer (1) recently proposed the use of raw linseed oil for the preliminary treatment of the wood of the violins while the completed instruments are in the condition known as "in the white" that is before the varnish has been applied. This simple application of linseed oil to the wood produced a number of desirable advantages, which suggest that it might have been used by the old Italian masters. An additional effect has now been found that was not anticipated originally, which may have pronounced influence on the tonal properties of the wood.

THEORETICAL CONSIDERATIONS

It is known (2, 3) that raw linseed oil upon oxidation over a period of years first passes through the rubbery or linoxyn stage and then finally becomes soft, sticky and "balsamic" in character. Although this ultimate degradation or oxidation product is extremely viscous it will exhibit slow-flow. For this reason it was considered desirable to determine if a liquid could be forced to move *inside* wooden plates if the plates impregnated with the liquid were set in vibration. If this movement did occur it would also be desirable to determine if the liquid appeared in higher concentrations at certain areas of the vibrating plates. This behavior of the liquid particles inside wooden plates would then be analagous to that of the grains of sand on the surface of Chladni plates. The change of position of free particles *in* or *on* vibrating plates to nodal areas may then be called Chladnian movement.

A number of devices were considered to determine if a liquid inside wooden plates would respond to movement to nodal areas when the plates were set in vibration. All were abandoned in favor of actual experiments on a violin "in the white." The top and the back of a violin are vibratable plates and as such should display modes of vibration and nodal areas. Although these plates are very complex systems because of their unique shape, the presence of longitudinal and lateral arches and the varying thicknesses (graduations), they should nevertheless exhibit some Chladnian effects when subjected to vibration. That these effects are produced may be readily demonstrated by placing a suitable small object on the back of a violin and plucking or bowing a string, whereupon the object will dance. But because of the shape and curvature of the plates of a violin a permanent pattern cannot be obtained on the surface. However if the wood of a violin were impregnated with a liquid, then a pattern might be obtained as the result of Chladnian movement when the violin is played.

EXPERIMENTAL DATA

As linseed oil is subject to oxidation which would introduce complications especially if the experiments were extended over periods of time it was decided to use an inert mineral oil, Squibb's medicinal mineral oil was found satisfactory for the purpose. So that any movement of the oil in and on the wood might be observed more readily, the mineral oil was colored red by alizarine-zinc-rosinate (1).

IMPREGNATING OIL

Squibb's Mineral Oil, medicinal grade	50.0 gms
Alizarine-zinc-rosinate	3.0 gms

This mixture was applied with a brush to the exterior of a violin in the white until further absorption became slow A large excess of oil was deliberately used so that if movement under vibration (actual playing) did occur sufficient oil would be re located to appear on the surface of the wood At the beginning of each experiment the violin was wiped thoroughly to be certain that all superficial oil was removed the surface of the wood was dry The violin was then played steadily for fifteen minutes each time in the normal manner and using violin music This method of placing the plates in vibration was considered preferable to that of using only open strings or one tone because it precisely represents actual playing conditions The following results were observed

(a) Oil in shiny wet patches appeared on the surface of the back of the violin but not on the top nor on the sides

(b) The oil areas on the back although not well defined appeared in the same locations after repeated experiments which are illustrated in Figure 1

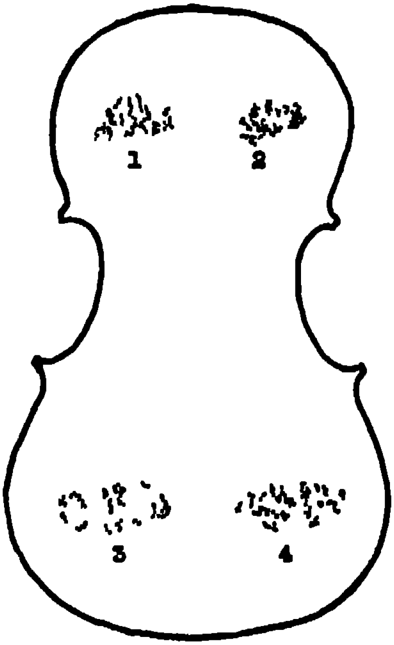

FIG 1 Location of oil areas on back of violin

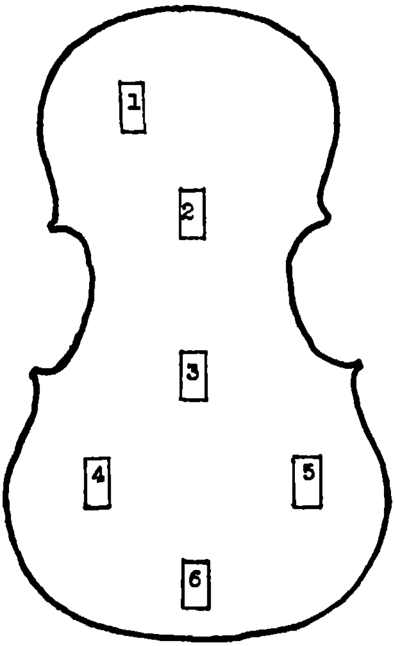

FIG 2 Location of specimens taken for oil analyses

(c) The oil patches disappeared from the surface of the back and were reabsorbed by the wood within several hours after the first experimental playings

(d) The oil areas gradually failed to appear on the surface of the back upon playing the violin and after about five days the oil patches did not appear Additional applications of oil caused the oil areas to appear again but these too gradually failed to appear after four or five days A total of four applications of oil were made extending over a period of eighteen months and in each instance oil areas appeared upon playing the violin to a decreasing extent for a few days and then failed to appear after four or five days

ANALYTICAL DETERMINATIONS

In order to investigate this behavior of the oil further analyses were made of specimens of the wood cut from various locations on the top and on the back The specimens were one inch by two inches in size and the locations are indicated on Fig 2 Specimens No 1 and No 2 were cut from the back immediately after playing the violin for the last time with the thought that the oil would not have an opportunity to return to a more uniform distribution in the wood The other specimens were cut thirty-six hours later with the thought that the oil would have had an opportunity to redistribute itself after the wood was subjected to vibration

When the violin was opened, preparatory to sawing test specimens from various sections, "reddish areas" were visible on the inside of the back corresponding to the oil patches on the outside The colored area corresponding to back Specimen No 5 was well pronounced This would indicate that the oil patches appeared on the inside of the plate also, but to a lesser extent than on the outside The center portion of the back on the inside was yellowish The inside of the front of the violin was deeply colored around the ff holes, the colored area extending several inches above and below the openings The inside center of the top was light yellow The side bouts were generally reddish

The specimens were extracted with benzene in a Soxhlet extraction apparatus, air dried to remove residual solvent, and then dried in an oven for eight hours at 105° C The weighings were made at once, and the percentage of benzene soluble matter was referred to the oven dried weight The results are summarized in Table I

TABLE I

DISTRIBUTION OF OIL IN THE WOOD

Specimen	*Location*	*Benzene Extractable*
No 1	Back	11 7%
2	Back	12 2%
3	Back	10 3%
3	Top	12 3%
4	Back	10 6%
4	Top	13 4%
5	Back	9 8%
6	Back	11 7%
6	Top	13 7%

INTERPRETATION OF RESULTS

Those areas on the back of the violin initially showing increased oil concentration, as the result of vibration, would at first thought be presumed to be nodal areas It would be reasonable to assume that the oil particles, like particles of sand on a vibrating Chladni plate, had been moved by vibration of the violin plate to these areas However, these portions of a violin back are the freest to vibrate being away from the node at the sound-post and from the sides of the violin to which the plate is attached These areas would normally be considered antinodes Moreover, the oil patches appeared upon playing the violin only for a short time after an application of the oil Since the plate as a whole has not apparently lost its property to vibrate then some other component which loses some of its property to vibrate relatively quickly, is responsible for the movement of the oil for a short time

This anomalous behavior may be explained by the concept that in a vibrating wooden plate, there may be two components in motion the plate as a whole and the internal cellular structure of the wood Vibration of the cell walls would then be more intense in areas where the vibration of the whole plate is constrained, and vice versa For example, the node of the back plate at the foot of the sound post would then be an area of maximum vibration of the cell walls of the wood The four areas indicated on Fig 1 where the violin plate is freest to vibrate would then be areas of minimum excitation of the cellular structure The oil patches observed were accordingly areas of least internal vibration ("nodal areas" with reference to the cell walls) and the oil concentrated in these areas in consequence After the oil had thoroughly permeated the cellular structure of the wood, its ability to respond to vibration was reduced (damping effect) and the movement of the oil when the violin was played no longer occurred

This theory would also account for the pronounced red areas on the inside of the top plate around the ff holes This portion of the top is freest to vibrate bodily resulting in less internal motion in the cell walls, which would cause a movement of the oil to these areas The absence of oil patches on the top plate may be due to the fact that the character of the wood (soft wood spruce) and the manner in which it is cut for violin making are not conducive to the migration of the oil when the plate is vibrated

The analytical data reveal that the oil eventually becomes distributed relatively uniformly in the wood irrespective of the original appearance of concentrated oil patches These analyses also indicate that any gravitational flow of oil will not account for the presence of oil patches on the back and the absence of oil spots on the top and the sides The experimental violin with its average content of over 11% oil was hung by its scroll in an *upright* position for a year and one-half, which included two summers (hot weather) If any gravitational flow of oil had occurred it would have been observed, and the difference in the oil contents of Specimen No 1 cut from the upper portion of the back and of Specimen No 6 cut from the lower portion of the back would have been appreciable The percentage content of oil in both specimens was the same Apparently the wood is capable of "holding" the oil so that vibration (after a preliminary period) and gravity cannot dislodge it

The effect of vibration on the wood of violins especially on its internal structure has received very little attention from previous investigators Moreover, the realization is growing that the old Italian masters subjected the wood of their instruments to some preliminary treatment which could account for the consistent superiority of their instruments Wood is a natural product the growth of which cannot be controlled or influenced, moreover wood is far from being a homogeneous material This fact would also suggest the need of some processing of the wood to render it more uniform and more suitable for a use in which its ability to vibrate properly is of prime importance

Nicholas (4) as the result of X-ray studies of the wood of an old Italian violin has stated that the only possible explanation of the difference between the diffraction rings obtained from a new violin and those from a Guarneri fiddle is that the wood in the latter has been subjected to some special treatment which tends to alter the cellulose structure Fry (5) has reported that the violin finished and not varnished has more power and mellowness in its tone but if it remains in this virgin state it becomes modified little by little and after a somewhat short time the tone becomes poor and feeble A better understanding of the effect of vibration on wood and variously treated wood will supply much needed information on this aspect of the Science of Violin-Making For example, a preliminary treatment that dampens secondary vibrations inside the wood and permits the primary bodily vibrations of the violin plates to prevail to an increasing extent should improve the acoustical properties of the wood

SUMMARY

The Chladnian movement initially observed in an oil-impregnated violin plate may be due to the vibrations inside the wood, that is, in its cellular structure The distribution of the oil in the wood eventually becomes relatively uniform and is not affected by gravity or vibration

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A NEW GENUS EUPTERELLA AND FIVE NEW SPECIES OF LEAFHOPPERS RELATED TO CICADELLA

(HOMOPTERA—CICADELLIDAE)

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In the study of the leafhopper fauna of Mexico a number of specimens were found in pine forest at altitudes varying from 5000 feet to 10,000 feet which are similar in appearance and structure These apparently belong to an undescribed genus and five species have been distinguished in the material at hand

Genus **Eupterella** n gen

Related to *Cicadella* The vertex is produced and bluntly or sharply angled The head is distinctly narrower than the pronotum The elytra with the second apical cell triangular and stalked The third and fourth apical cells formed by a vein which arises on the medius behind the cross nervures but before it forks to form the second apical and which extends to the posterior margin of the elytron Hind wing with four veins forming three open apical cells The radius and medius are connected with a cross vein but remain separated The male aedeagus is composed of a basal transverse portion which is bent abruptly back upon itself and produced into an erect whip like terminal portion

Genotype *Eupterella mexicana* n sp

Eupteryx huachucae Lawson is apparently congeneric with this material

Eupterella mexicana n sp

In general appearance resembling a species of *Cicadella* but with distinct genitalia Length 3 5-3 8 mm

Vertex produced bluntly angled median length three fourths as great as the basal width between the eyes Head including eyes much narrower than pronotum and about half as long as pronotum

Color Vertex creamy with a pair of elongate diagonal black spots extending from apex toward eyes just above margin The portion next the eye is broadened Pronotum creamy with six dark spots There is a pair on the anterior margin, one on each side just posterior to the outer portion of the vertex at its base There is a pair on the outer portion of the disc, more widely separated than the anterior pair Also a spot on the outer margin of pronotum each side just posterior to the outer margin of the eye Scutellum creamy, the basal angles orange to reddish Elytra pale flecked and mottled with reddish pigment There is an elongated reddish spot on the costal margin just before the anterior apical nervure Veins on apical portion pale margined with brown Face pale in female infuscated in male with a large black spot just beneath the eye and a transverse black spot next each eye on face.

Genitalia Female seventh sternite long the posterior margin slightly concavely sloping to a broad produced lobe-like apex which is keeled at middle Male plates broad and elongate convexly rounded, abruptly narrowed near apex with narrow blunt upturned apices Styles narrow, elongate apical portion is foot like in appearance with the sharpened toe-like portion directed outwardly The aedeagus in lateral view is transverse at base It is then bent back upon itself downward, then upward to form a long, slender apical whip This portion is decidedly broadened after being curved back and as it crosses aedeagus shaft

Holotype male collected at Carapan, Mich Mexico October 2, 1941 Allotype female from Laguna de Zempoala, Mor October 21 1945 male and female paratypes from Carapan, same date, Laguna de Zempoala, same date Tres Cumbres, D F, October 21, 1941, Desierto de los Leones D F, July 11, 1927, and August 1, 1932, and the state border between Mexico and Mich, K 139, September 28, 1945 The 1941 material was collected by Caldwell, Good, Plummer and DeLong, and the 1945 material by Plummer, DeLong, Hershberger and Elliott

Eupterella frigida n sp

Resembling *mexicana* in general form and appearance but with head blunter and with distinct male genital structures Length 3 5–3 8 mm

Vertex produced bluntly angled median length about half the basal width between the eyes longer at middle than next the eyes less than half as long as pronotum

Color Quite variable Vertex usually some shade of yellow with a pair of black transverse diagonal spots just above apex and extending toward eyes Pronotum yellow to reddish brown When sufficiently pale with a pair of black spots on anterior portion one just posterior to inner margin of each eye and a pair on posterior portion of disc which are more widely separated A third pair of spots are on the outer margins of the pronotum one just posterior to the outer margin of each eye Scutellum pale to brownish Elytra variously marked usually mottled Posterior portion usually dark or smoky especially the margins of the veins Face in female usually pale with a dark transverse spot above each antenna and between eyes In male the face is usually dark brown to black often reaching spots above and leaving a white band just beneath vertex margin

Genitalia Female seventh sternite with short lateral angles posterior margin sloping to a well produced bluntly angled apex Male plates and styles as in *mexicana* The aedeagus in lateral view has a more expanded aedeagus shaft with shorter and more approximate dorsal spine like processes Also the portion crossing the shaft after curving is narrow not expanded as in *mexicana* In ventro caudal view the apical portion is broadened then tapered to a pointed apex

Holotype male collected at Rio Frio D F Mexico October 18 1941 Allotype female and para type females were collected at the same locality October 7 1941 Paratype females also collected October 18 1941 All of these were taken by DeLong Good Plummer and Caldwell and female paratypes taken at the same locality October 10 1945 by DeLong Hershberger and Elliott

Eupterella acuminata n sp

Resembling *mexicana* in general form but smaller in size with a more produced head and with distinct genitalia Length 3 mm

Vertex rather pointed angularly produced median length about two thirds the basal width between the eyes a little blunter in the male

Color Pale yellow marked with black brown and red Vertex usually tinted with bright red on basal two thirds Apex with a black line sometimes quite broad extending toward eye on either side Pronotum pale tinged with red and yellow with two separated black spots just back of margin Scutellum yellowish the basal angles brown or black Elytra pale with broad and reddish markings Anterior portion mottled with brown corium and posterior half of clavus with reddish or brownish dots The posterior costal area reddish and smoky veins pale Face pale unmarked in both sexes

Genitalia Female seventh sternite with long lateral margins from which the posterior margin is strongly concavely produced to form a median lobe which is about as long and half as wide as basal portion and is rounded at apex Male plates and styles similar to *mexicana* The aedeagus is expanded on the shaft and the apical whip like portion is slender as viewed both from the lateral and ventral views

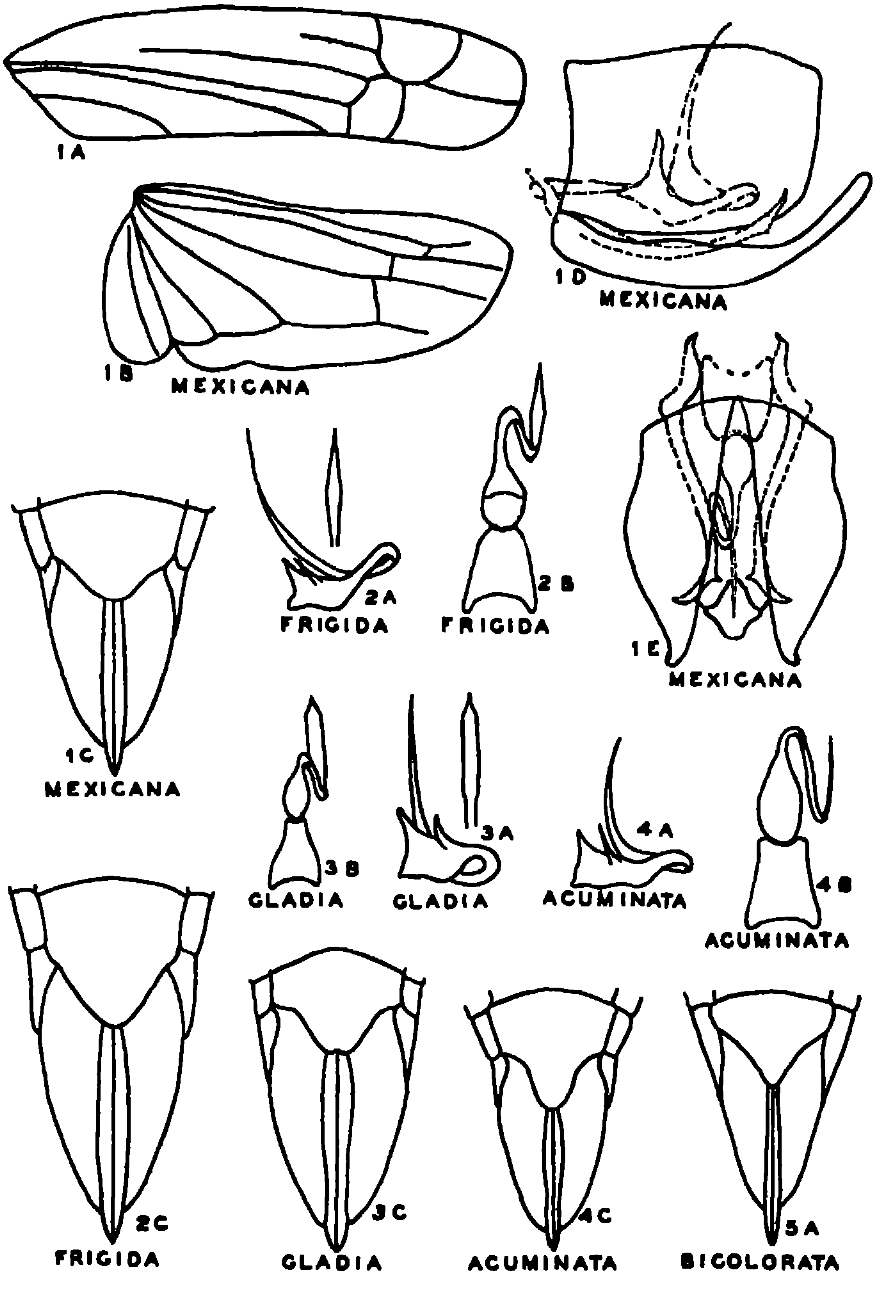
Holotype male allotype female and paratype male collected at Orizaba Veracruz Mexico October 17 1941 by Plummer Caldwell Good and DeLong A female paratype was taken at Tehuacan Pue on the same day by the same collectors and a male paratype at Saltillo Coah Mexico September 23 1941 by Good Caldwell and DeLong

Eupterella gladia n sp

Resembling *frigida* in form and general appearance with blunt vertex and distinct male genitalia Length 3 5–3 7 mm

Vertex short almost rounded in male median length three fourths as great as the basal width between the eyes in female and more than one half as long in the male

Color Somewhat variable female usually paler than male The vertex in the male is yellow with the elongate spots at apex fused to form a transverse band Pronotum with the four spots on anterior portion conspicuous The two on the posterior portion of disc are fused



Illustrations of species of *Eupterella* as labeled

1 *E mexicana*—(1a) forewing, (1b) hind wing (1c) ventral view of apical portion of female abdomen, (1d) lateral view and (1e) ventral view of male genital structures

2 *E frigida*—(2a) lateral view and (2b) ventro-caudal view of male aedeagus, (2c) ventral view of apical portion of female abdomen

3 *E gladia*—(3a) lateral view and (3b) ventro-caudal view of male aedeagus, (3c) ventral view of apical portion of female abdomen

4 *E acuminata*—(4a) lateral view and (4b) ventral view of male aedeagus, (4c) ventral view of apical portion of female abdomen

5 *E bicolorata*—(5a) ventral view of female abdomen

with a transverse dark brown band which extends almost across the posterior margin of the pronotum and is widened at middle Scutellum with anterior half dark brown posterior half pale Elytra with a brown area in the basal claval area and a diagonal brownish area extending from costa to posterior half of clavus Veins on posterior portion pale bordered with brown Face in male pale brownish with the large spots below the eyes and the transverse spots between eyes on face conspicuous

Genitalia Female seventh sternite rather long the posterior margin rather definitely concavely excavated each side of a produced median lobe which is about half as wide as the basal width Male plates and styles similar to those of *mexicana* Aedeagus shaft broadened The anterior dorsal spine like process is conspicuous The apical portion of the aedeagus whip structure is quite broadened to near its apex where it is rather abruptly narrowed to a pointed apex appearing sword like

Male holotype from Mexico City September 2 1937 by Dampf Allotype female from State Border of Mexico and Mich collected September 28 1945 by Plummer DeLong Hershberger and Elliott Male paratypes from Rio Frio D F October 10 1945 by DeLong Hershberger and Elliott and male paratypes from Santa Rosa D F Mexico July 24 1932 by Dampf A series of female paratypes referred to this species were taken at Mexico City September 2 1937 by Dr Dampf

Eupterella gladia var **limba** n sp

Resembling *gladia* in general form and appearance but with different coloration Length 3 5 mm

Color Vertex yellow broadly bordered with black along margin from apex to base of eyes Pronotum marked with dark brown or black so as to show only a yellowish area on the disc and a faint yellowish border on the posterior margin Scutellum with the anterior half black the posterior half yellow Elytra rather heavily marked with brown Light areas are on the anterior portion and the apical portion of clavus Veins on anterior half of elytra inconspicuous On the posterior half they are pale dark margined Face in both sexes black with a white transverse band just beneath margin of vertex Antennae and legs bright yellow

Genitalia Female last ventral segment with long lateral margins the posterior margin sloping and produced to form a median rounded lobe more than half as broad as basal portion of segment Male genital structures similar to those of *gladia*

Holotype male collected at Tres Cumbres D F October 21 1941 and female allotype from Campan Mich October 2 1941 by DeLong Plummer Good and Caldwell Paratype male from Desierto de los Leones D F November 5 1933 by Plummer

Eupterella gladia var **bifasciata** n sp

In general appearance resembling var *limba* but with different colorations Length 3 mm

Vertex well produced blunt at apex median length about two thirds the basal width between eyes

Color Vertex black except a transverse white spot at base Pronotum black a pair of proximal pale spots on disc and central half of posterior margin white bordered Scutellum white with the basal and apical angles black Basal half of elytra black except a small spot on inner margin of each clavus at apex of scutellum and an elongate spot on middle of each costa Posterior half pale with veins broadly margined with brown Apical cells smoky Face white with a heavy black transverse band across face between eyes forming a white band between this and margin of vertex

Genitalia Female segment produced and blunt at apex as in *gladia*

Holotype female from Tuxtla Gutierrez Mexico June 4 1926 collected by Dr Dampf

Eupterella bicolorata n sp

Resembling *mexicana* in general form but with distinct coloration Female only Length 3 mm

Vertex rather strongly produced and bluntly angled

Color Vertex white with a narrow black border extending along each side from apex to eyes Pronotum white bordered with black along anterior margin and rather broadly along the lateral margins of the pronotum Scutellum white the basal angles with small black spots

Elytra marked with the same sharp definition of color The clavus entirely yellow except a small black spot on anterior basal angle Remainder of elytra predominantly black An elongate spot on central portion of costa and inner portions of anteapical cells pale The veins on apical third are pale, widely bordered with brown. Apical portion smoky

Genitalia Female seventh sternite rather long posterior margin strongly produced and sloping on each side to form a produced bluntly rounded median lobe

This unique female is described because of its distinctive and contrasting color pattern in spite of the fact no male specimen is available

Female holotype collected at Zitacauro, Mich , Mexico, September 29 1941, (Km 160) by DeLong, Good, Caldwell and Plummer

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PLANKTON POPULATION OF CERTAIN LAKES AND STREAMS IN THE ROCKY MOUNTAIN NATIONAL PARK, COLORADO

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An extensive survey of the plankton population of the streams in the Ohio River watershed was made from 1939-1942 (Brinley and Katzin, 1944) This study revealed the fact that the northern tributaries of the Ohio River support a much larger phytoplankton population in species and numbers than the southern tributaries This difference in plankton distribution is attributed to the fact that the northern streams flow through densely populated areas, the farm lands are fertile and the surface waters are generally polluted with human and industrial wastes The southern streams, on the other hand, pass through sparsely populated regions where the soils are poor and the streams are less likely to be enriched with organic pollution The algae population seems to be directly correlated with the amount of decomposed organic matter in the stream Studies of the White (Brinley, 1942a) and the Cumberland Rivers (Brinley, 1942b) clearly showed that isolated sources of heavy organic pollution greatly increased the growth of algae, in numbers and species, in the stream below the entrance of the sewage

It is desirous to obtain more information on the relation of stream fertility to the plankton population by studying streams which are free from organic pollution Such streams do not exist in the state of Ohio so it seemed advisable to study the problem in sparsely populated mountain districts where the streams are free from human wastes and where the decomposition of natural organic matter, vegetation, leaves, humus, etc , is at a minimum

Permission was freely given by the National Park Service to conduct these studies in the Rocky Mountain National Park The writer wishes to express his appreciation to David Canfield, Superintendent, J Barton Herschler, Chief Ranger, and Edwin C Alberts, Park Naturalist, for all facilities of the Park which were so graciously given

METHODS AND PROCEDURE

The present studies were made in the Park from June 13 to July 22, 1949 In the beginning of the study, samples of water were collected in wide mouth bottles and an attempt was made to make qualitative and quantitative determinations of the population of plankton and to express the quantitative results in parts per million as recorded in the previous publications (Brinley, 1942) However, it was soon found that the plankton population of these streams and lakes was so low that collections of small samples yielded very few individuals and the volume was less than one part per million as compared with several parts per million as found in the Ohio River Basin It was decided therefore to discontinue the small sample collections and to use a plankton net Approximately ten to twenty gallons of water were filtered through the net by sweeping the net through quiet water or allowing running water to flow through the net The fifteen milliliters of catch were then concentrated to one ml by centrifuging This method was largely qualitative and thus no volume determinations were made The lake samples were taken from the shore line on the leeward side of the lake Samples from the streams were largely taken from boulders along the shore by allowing the water to flow through the net

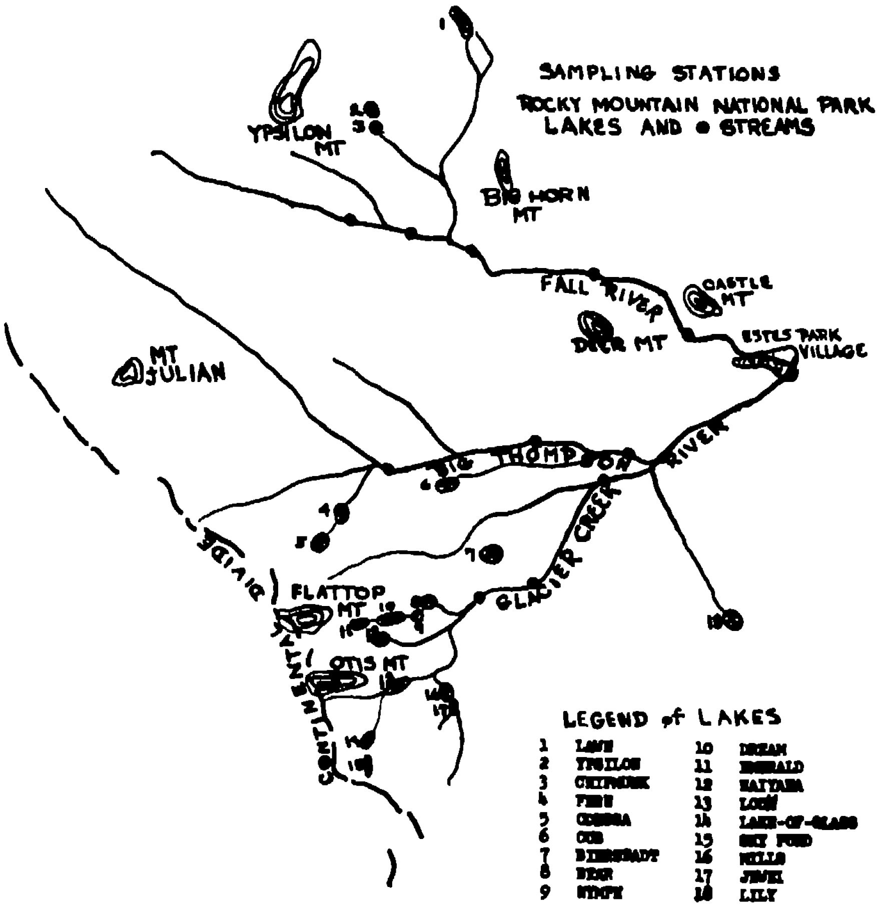

Fig 1 Map of the area from which collections were made

The stream beds and lakes in the Park were glacier formed and thereby in many cases two to four lakes are terraced up the gorges and during high water these lakes are connected by a flowing stream The lakes studied were conveniently arranged in related groups as they occur in the common valley (see map tracing) In most cases the lakes had stony bottoms and were partly filled with loose boulders that had descended from rocky ledges above The rocks along the shore line were covered with unidentified filamentous algae and a layer of silt of various depths covered the bottom between the rocks and boulders During the month of June, snow banks extended to the edge of the water in most of the lakes of high elevations

The typical mountain streams flowed over rocky valley floors and during high water in June the samples collected contained large amounts of sand which seriously interferred with the plankton determinations Unidentified filamentous algae covered the rocks

DISTRIBUTION OF PLANKTON

LAKES

Group I

Lake	Elevation Ft	Temp C	Plankton	Relative Population	Date
Bear	9 600	10	Diatoms		
			Asterionella gracillima	abundant	6/18
			Diatoma vulgare	few	
			Navicula sp	few	
			Cymbella sp	few	
			Synedra	scarce	
			Desmids		
			Closterium subcostatum	scarce	
			Staurastrum sp	scarce	
			Green Algae		
			Cryptomonas ovalis	scarce	
			Volvox	scarce	
			Protozoa		
			Peridinium	scarce	
			Copepods		
			Cyclops	few	
		16	Diatoms		7/15
			Asterionella gracillima	abundant	
			Diatoma vulgare	few	
			Navicula sp	few	
			Desmids		
			Closterium sp	few	
			Green Algae		
			Dinobryon sp	abundant	
			Volvox	one colony	
			Cryptomonas ovalis	scarce	
			Cladocera		
			Daphnia pulex	abundant	
Nymph	9,800	17	Diatoms		6/30
			Navicula sp		
			Diatoma vulgare	abundant	
			Desmids		
			Penium closterioides	few	
			Micrasterias radiosa	few	
			Staurastrum sp	few	
			Copepods		
			Cyclops	few	
			Rotifers		
			Anuraea	abundant	
Dream	10,000	7	Diatoms		6/30
			Asterionella	abundant	
			Diatoma vulgare	few	
			Synedra	few	
			Green Algae		
			Cryptomonas erosa	scarce	
		8	Diatoms		7/8
			Asterionella	abundant	
			Diatoma vulgare	few	
			Desmids		
			Microsterias radiosa	few	
			Copepods		
			Cyclops	scarce	
			Rotifers		
			Anuraea	scarce	

DISTRIBUTION OF PLANKTON—(*Continued*)

LAKES

Group I—Continued

Lake	Elevation Ft	Temp C	Plankton	Relative Population	Date
Emerald	10 200	8	Diatoms		7/8
			Asterionella	abundant	
			Diatoma vulgare	few	
			Desmids		
			Micrasterias radiosa	few	
			Green Algae		
			Cryptomonas erosa	scarce	
Group II					
The Loch	10 700	8	Diatoms		7/11
			Diatoma vulgare	few	
			Green Algae		
			Volvox	abundant	
			Cryptomonas erosa	few	
			Copepods		
			Cyclops	few	
Lake of Glass	10 800	6	Diatoms		7/11
			Asterionella	abundant	
			Green Algae		
			Volvox	abundant	
			Cryptomonas erosa	few	
			Copepods		
			Cyclops	few	
			Rotifers		
			Noteus	few	
Sky Pond	11 100	6	Diatoms		7/11
			Asterionella	few	
			Green Algae		
			Volvox	abundant	
			Cryptomonas erosa	few	
Group III					
Mills	11 500	9	Diatoms		7/18
			Navicula	few	
			Desmid		
			Cosmarium	few	
			Rotifers		
			Anuraea	few	
Jewel	11 600	9	Diatoms		7/18
			Navicula sp		
			Diatoma vulgare		
Group IV					
Fern	9 500	7	Diatoms		6/25
			Navicula sp	abundant	
			Diatoma vulgare	many	
			Synedra	few	
			Green Algae		
			Cryptomonas erosa	few	
Odessa	10 000	5	Diatoms		6/25
			Navicula sp	few	
			Rotifers		
			Anuraea	few	
Group V (Miscellaneous)					
Bierstadt	9 500	13	Diatoms		6/19
			Diatoma vulgare	many	
			Navicula		
			Desmids		
			Cosmarium constrictum	few	
			Closterium subcostatum	few	
			Green Algae		
			Euglena viridis	few	
			Phacus pyrum	very few	
			Protozoa		
			Vorticella	very few	

DISTRIBUTION OF PLANKTON—(*Continued*)

LAKES

Group V—Continued

Lake	Elevation Ft	Temp C	Plankton	Relative Population	Date
Cub	8,600	17	Diatoms		6/21
			Diatoma vulgare	few	
			Cladocera		
			Daphnia pulex	very abundant	
			Rotifers		
			Anuraea	abundant	
Chipmunk	9,900	17	Diatoms		6/23
			Diatoma vulgare	few	
			Navicula sp	few	
			Desmids		
			Euastrum abruptum	few	
			Cosmarium constrictum	few	
			Closterium subcostatum	few	
			Cladocera		
			Daphnia pulex	few	
			Rotifers		
			Anuraea	abundant	
			Polyarthra	few	
Lily	9,900	18	Diatoms		6/24
			Navicula	abundant	
			Desmids		
			Micrasterias radiosa	few	
			Green Algae		
			Chlamydomonas sp	few	
			Volvox	few	
			Euglena sp	very few	
			Protozoa		
			Ceratium	very few	
			Cladocera		
			Daphnia pulex	many	
			Copepods		
			Cyclops	few	
			Rotifers		
			Anuraea	few	
			Noteus	few	
Haiyaha	10 700	6	Diatoms		7/8
			Asterionella	few	
			Diatoma vulgare	few	
			Green Algae		
			Cryptomonas ovata	very few	
			Rotifers		
			Anuraea		
			Noteus		
			Copepods		
			Cyclops	few	

STREAMS

Streams	Location	Temp C	Plankton	Relative Population	Date
Big Thompson	Below "Pool"	6	Diatoms		6/18
			Navicula	many	
			Synedra acus		
			Desmids		
			Closterium subcostatum		
		8	Diatoms		7/10
			Navicula	many	
			Nitzschia	few	
		9	Diatoms		7/20
			Navicula	few	

DISTRIBUTION OF PLANKTON—(*Continued*)

STREAMS

Stream	Location	Temp C	Plankton	Relative Population	Date
	Stead's Hotel	8	Diatoms		7/3
			Navicula sp	few	
			Diatoma vulgare	few	
			Desmids		
			Closterium sp	few	
			Rotifers		
			Anuraea		
		8	Diatoms		7/10
			Navicula	few	
		11	*Navicula*	few	7/20
	Moraine Park	8	Diatoms		6/27
			Navicula	few	
			Diatoma vulgare	few	
			Desmids		
			Cosmarium constrictum	few	
			Closterium subcostatum		
			Protozoa		
			Loxodes		
		8	Diatoms		7/10
			Navicula sp	few	
			Diatoma vulgare	few	
			Closterium subcostatum	few	
			Cosmarium constrictum	few	
		11	Diatoms		7/20
			Diatoma vulgare	few	
			Navicula sp		
			Desmids		
			Cosmarium constrictum		
			Closterium subcostatum		
Glacier Creek	Below Bear Lake	8	Diatoms		7/2
			Asterionella	many	
			Navicula	many	
			Nitzschia	few	
			Synedra	few	
			Green Algae		
			Cryptomonas erosa	very few	
	Sprague's Lodge	8	Diatoms		7/2
			Asterionella	many	
			Navicula	few	
			Nitzschia	few	
			Diatoma vulgare	few	
			Desmids		
			Closterium	few	
	Mouth of Mill Creek	8	Diatoms		7/2
			Asterionella	few	
			Navicula	few	
			Nitzschia	few	
			Green Algae		
			Cryptomonas erosa	very few	
		10	Diatoms		7/15
			Asterionella	few	
			Navicula	few	
			Desmids		
			Micrasterias radiosa	few	
Fall River	Chasm Falls	5	Diatoms		7/9
			Navicula	very few	
		8	Diatoms		7/16
			Navicula	few	
	End of Valley Camp	8	Diatoms		7/9
			Navicula sp	few	
			Diatoma vulgare	few	
		9	Diatoms		7/16
			Navicula sp	few	

DISTRIBUTION OF PLANKTON—(*Continued*)

STREAMS

Stream	Location	Temp C	Plankton	Relative Population	Date
	Fall River Lodge	5	Diatoms		7/6
			Navicula sp	few	
			Diatoma vulgare	few	
			Rotifers		
			Noteus	very few	
			Protozoa		
			Actinosphaerium sol	very few	
		8	Diatoms		7/9
			Navicula sp	few	
			Diatoma vulgare	few	
			Desmids		
			Closterium sp	few	
			Protozoa		
			Cyclidium		
	Highway Bridge U S 34	7	Diatoms		6/28
			Navicula	few	
			Diatoma vulgare	few	
		8	Diatoms		7/9
			Navicula sp	very few	
			Protozoa		
			Cyclidium	very few	
	Below Sheep Lake	7	Diatoms		6/28
			Navicula	few	
			Green Algae		
			Tetraspora	few	
	Above Estes Park		Diatoms		6/28
			Navicula	few	
			Diatoma vulgare	few	
			Desmids		
			Cosmarium rostratum	few	

DISCUSSION AND SUMMARY

A study of the data presented shows that the diatoms were the most abundant group of planktons in both the lakes and streams followed in numbers by the desmids and an occasional green flagellate and protozoan In some lakes Daphnia Cyclops and rotifers were abundant The small number of species may in a large part be due to the low temperature in most cases below 10 degrees Centigrade The species found in the Park as listed in this paper are the typical cold water forms that occur in the Ohio Basin (Brinley and Katzin 1942) The total plankton volume in the mountain streams is much lower than the volume of the same species in the Ohio River Basin under similar temperature conditions which I believe can be attributed to the fertilizing action of the organic pollutants in the Ohio stream

A comparative study of the streams and lakes in the Park showed no specific differences in the plankton algae however the population density of individual species were generally higher in the lakes Daphnia and Cyclops were abundant in Bear Cub and Lily lakes Rotifers were numerous in Chipmunk Cub and Lily lakes Hellgrammites and leeches were abundant in the latter lakes and these lakes also supported a heavy population of water lilies

A careful study of the distribution records indicates a possible similarity in the plankton algae in closely related lakes The lakes in group one Bear Nymph Dream and Emerald are all located in the Tyndall Glacier Gorge The characteristic specie of algae found in three of these lakes is the diatom *Asterionella* It is also interesting to note that this diatom was widely distributed in Glacier Creek which receives the outlet from Bear Lake and Glacier Gorge The individual specimens of this fragile diatom in Glacier Creek were always broken which indi cates that the origin of this specie was in the lakes and not a direct product of the stream A few *Asterionella* were, however, found in Lake Haiyaha, Lake-of-Glass, Sky Pond, and The Loch Volvox was found abundantly in the Loch Vale Lakes (group 2), The Loch, Lake-of-Glass and Sky Pond, and only occasionally elsewhere

The stream plankton was typically diatoms There is a tendency for the desmids to increase in the Big Thompson River as it flows through the meadows in Moraine Park

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The New Gray's Manual of Botany

It has been forty two years since Gray s Manual appeared in a new edition In that period most of us have become so familiar with the Seventh Edition of 926 pages that in some of our homes it has occupied a place comparable to that of the Bible the dictionary or the telephone directory The 8th Edition with its 1632 pages is of course a much larger book The addition of 706 new pages in spite of the extra thin quality of the paper, naturally increases its bulk

The extra pages represent the work of specialists who have revised many genera with the addition of new species In recent years intense study of collections made in eastern Quebec and Newfoundland have brought to light many isolated or relect species while studies now being carried on in Virginia, Missouri and Minnesota show that three or four times as many new species which should be included in future editions, than the inclusion of theCanadian species has totaled in the 8th Edition

When Asa Gray issued his first Edition in 1848 he had the assistance of three well known botanists of that period Carey, Oakes and Olney in the preparation of the Eighth Edition Dr Fernold had contributions from 400 "enthusiastic cooperators," as he calls them Two illustrations will indicate the change in size In the Seventh Edition the genus *Rubus* contains 38 species and in the Eighth it is expanded to 205 species This has necessitated the use of 45 pages as over against the 6 pages in the earlier edition Similarly in the treatment of the genus *Crataegus* The number of species is increased from 65 to 103 and this has added 33 new pages To lesser extent the increase in size of the current edition is also due to the fuller list of localities in which plants occur and also a wider offering of English names The editor was advised by the Latin professor at Harvard Dr Pease, to translate all Latin names even such common ones as *alba* or *albiflora*, since "nowadays no understanding of the simplest Latin words can be assumed '

With regard to the keys in the new edition, considerable change has been made The dichotomous keys with the use of the small letters often pages apart, are not nearly so convenient as the keys in the Seventh Edition In the latter the major division of the keys are indicated in heavy black faced type which makes the alternative alphabetical letter easier found by the beginner and elementary student In such families as the Cruciferae and the Compositae the omission of the Artificial Keys is a great loss to the beginning student and the small "Key to the Subfamilies and Tribes" (p 1358) is scarcely adequate for sophomores beginning systematic study of the Composites

On the whole the new edition of Gray's Manual is a notable achievement in this field of botany and brings into the purview of the systematists in the schools and colleges, the additions and revisions that specialists have been working upon during recent years But the new edition rather removes the Manual from the class of a ready household companion and text-book for beginners, to the sphere of a reference work A position comparable to the library status occupied by the 3 volume illustrated set of Britton and Brown's Flora The enlarged format militates against its use by field classes The fact remains that the new edition is a splendid work for the serious student or collector with some knowledge of systematic botany —*H H M Bowman*

Gray's Manual of Botany, 8th Edition, illustrated, July, 1950 A Handbook of the Flowering Plants and Ferns of the Central and Northeastern United States and Adjacent Canada Edited by Merritt L Fernald Harvard University American Book Company, $9 50

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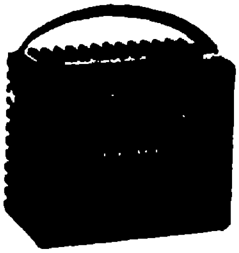

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THE OHIO JOURNAL OF SCIENCE

VOL L NOVEMBER 1950 No 6

VARIATIONS OF LISTERIA MONOCYTOGENES PRODUCED BY BETA PARTICLES FROM RADIOPHOSPHORUS

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One of the most widely used methods to induce variations in micro organisms is the application of various types of radiation Ultraviolet light and X rays have been used most frequently for this purpose While beta particles have previously been used to irradiate bacteria they have usually been employed to determine the lethal effects Beta radiations were obtained from cathode ray tubes or from some naturally radioactive substance which also emitted alpha particles or gamma rays Recently the radioactive isotope of phosphorus commonly referred to as P^{32} which emits only beta particles has been made available One of the advantages of using this source of beta particles is that the radiophosphorus in the form of a phosphate can be dissolved and distributed uniformly throughout the medium This minimizes the absorption of the beta particles by materials other than the bacterial cell substance and the medium thus making possible the more accurate estimate of the amount of radiation and the number of cells which are affected by it

Although von Schroetter (1927) observed some interesting morphological changes while studying the action of radium on microorganisms over twenty years ago the use of ionizing radiations other than X rays to induce variations in microorganisms has largely been limited to the past ten years Whelden (1940) demonstrated variant production in bacteria by low voltage cathode rays Neutrons were shown to induce variation in *Penicillium notatum* (Myers and Hanson 1945 Hanson Myers Stahly and Birkeland 1946) and beta radiations from radiophosphorus were shown to produce variations in *Neurospora crassa* (Giles and Lederberg 1948) Morphological and physiological variations of *Bacillus globigii* induced by beta particle irradiation were reported previously (Hunter Stahly and Myers 1948) In the present study the effects of ionizing radiations on the morphologic biochemical immunogenic and pathogenic characteristics of *Listeria monocytogenes* were investigated

MATERIALS AND METHODS

The Ohio State University stock strain 144 of *Listeria monocytogenes* was selected as the test organism This strain formed small convex grayish-white colonies with a regular periphery and produced a small zone of beta hemolysis on horse blood agar Less than 1 per cent of the colonies appeared slightly larger and rougher than the rest A smooth colony was picked and restreaked no more rough colonies appeared during serial transfer on five plates A colony picked from the fifth plate was inoculated upon a blood agar slant and was kept as the stock culture

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The radiophosphorus used in these experiments was obtained from the Atomic Energy Commission at Oak Ridge Tennessee in the form of potassium dihydrogen phosphate with a specific activity of approximately two P^{32} atoms per ten million phosphorus atoms A 2 per cent solution of the phosphate was prepared at the Ohio State University Medical Center A control solution which contained the same concentration of non radioactive potassium dihydrogen phosphate was prepared also The amount of standard sodium hydroxide required to adjust the pH of the control solution to 7.0 was determined this amount of the same base was also added to the radioactive solution to adjust it to the same pH Both of these solutions were sterilized by autoclaving for 20 minutes at 15 pounds pressure

The organism was grown on a blood agar slope for 24 hours and then the cells were suspended in 5 ml of doubly distilled water Both the exposure tube and the control tube were prepared by transferring 1 ml of the bacterial suspension by means of an automatic pipette into 10 ml of each of the phosphate solutions At the time of inoculation the radiophosphate solution had an activity of 120 micro curies per ml Application of the formula of Marinelli et al (1948) modified by an estimate of the amount of beta ray absorption by the test tube resulted in a calculated value of approximately 45 000 equivalent roentgen units to which the culture was exposed during 11 days

At 24 hour intervals samples were withdrawn from both the exposure tube and the control tube and streaked over a series of beef infusion horse blood agar plates These plates were examined after 48 hours of incubation at 37 C and any colony which appeared different from the stock colonies was picked and streaked upon a medium of the same composition On the plates streaked from the control tube no colonies were detected which differed from the normal colonies of the parent strain From the exposure tube twenty one colonies were selected which differed from the parent strain in some morphological characteristic discernible under the stereoscopic microscope One of these strains (number 4) was lost during sub culture procedures The other twenty strains were examined with respect to their morphologic antigenic physiologic and pathogenic characteristics

EXPERIMENTAL RESULTS

Morphological Characteristics

The twenty strains which were isolated differed from the parent strain and generally from each other in one or more of the following characteristics size opacity elevation color texture roughness and degree of hemolysis on blood agar of the colonies and the size shape and staining reactions of the cells

Agglutination and precipitation reactions

An antiserum was prepared against the unirradiated parent strain by the procedures recommended by Paterson (1940) for the demonstration of a somatic antigen common to all types of *Listeria monocytogenes* Cell suspensions of each of the twenty isolated strains were prepared in the same manner as the immunizing antigen was prepared The original immunizing antigen was used for the parent strain in the agglutination tests

In Table I the titers of the parent strain antiserum for each cell suspension are recorded The tests were set up in geometric series starting at a dilution of 1:20 Readings were made after incubation for 12 hours at 37 C and again after storage overnight at 4 C No differences were observed in the two readings

The results of these agglutination reactions indicate that strains 3 and 10 either were variants of *L monocytogenes* which had been altered sufficiently to result in a change in the surface antigens or were grampositive non sporeforming motile contaminants Strains 19 and 21 agglutinated spontaneously in saline when agglutination reactions were attempted Since physiological reactions did not characterize these strains as *L monocytogenes* each of them was tested by the precipitin reaction Although strains 9 and 16 were agglutinated typically by antiserum prepared against the parent strain, they were so different from the parent culture physiologically, that they were included in the precipitin reactions which were run subsequently.

For the precipitin reactions the same antiserum was used as had been used for the agglutination tests. The antigens were prepared by growing each strain in 1 per cent glucose yeast extract broth for 24 hours after which the cells were washed twice in distilled water and suspended in physiological saline. A count was made on each suspension by the serial dilution method of McCrady (1918) and the most probable numbers were determined by consulting the tables of Hoskins (1934). Each suspension was adjusted to approximately 50 million viable cells per ml by the addition of normal saline. These suspensions were frozen and thawed three times by placing them in the deep freeze unit overnight and allowing them to thaw out the following day. The antigens were then clarified by filtration through Seitz disks. Precipitation tests were set up by placing 0.1 ml of the antiserum in a series of precipitin tubes and overlaying the antiserum with 0.1 ml of various dilutions of each antigen. The controls used were antiserum plus saline, antiserum plus 1:10 yeast extract broth, antiserum plus 1:10 nutrient broth, and normal serum from an uninoculated rabbit plus varying dilutions of the antigen of the parent culture. Reactions were read after 3 hours at 37 C and again after 24 hours at 7 C.

TABLE I

AGGLUTINATION TITERS OF THE ANTISERUM OF THE PARENT STRAIN FOR VARIANTS OF *Listeria monocytogenes*

STRAINS	DILUTION OF ANTISERUM OF PARENT STRAIN								Saline Control
	1/20	1/40	1/80	1/160	1/320	1/640	1/1280	1/2560	
Parent 1 2 5–8 11–18, 20	+	+	+	+	+	+	−	−	-
9	+	+	+	+	+	+	+		
19 21	+	+	+	+	+	+	+	+	+
3 10	−	−	−			-		−	

All of the controls were negative. Strains 3, 9, 16, 19 and 21 showed precipitin reactions similar to those of the parent strain. Strain 10 showed no reaction when combined in any concentration with the antiserum prepared against the parent strain. This strain could have resulted from a mutation which inhibited the production of some constituent which was an essential part of each antigenic component of the cell. But, since it could not be established that this strain was a progeny of the parent strain through antigenic or physiologic characteristics, it was not included in the subsequent studies.

Physiological reactions

Abilities to ferment carbon compounds and litmus milk, to reduce nitrate, to produce acetylmethylcarbinol and indol, and to give a positive methyl red reaction were tested with each strain in order to determine variations in physiological characteristics.

Each strain was inoculated into media containing 1 per cent of the compounds listed in Table II. These media were prepared by adding solutions of the carbon sources, which had been filtered through Seitz disks, to a 1 per cent tryptone broth adjusted to pH 7.0 and to which had been added brom cresol purple indicator. While the majority of the strains fermented the same carbohydrates, numbers 3, 8, 9, 16, 19 and 21 differed widely. Number 3 fermented mannitol and numbers

3 and 16 fermented galactose both of which the parent strain was unable to utilize They as well as strains 8 9 19 and 21 lost the ability to ferment one or more of the carbohydrates which the parent strain fermented

Duplicate tubes of litmus milk were inoculated with each strain incubated at 37 C and observed at two hour intervals for 14 hours and again after 24 48 and 72 hours Tubes which showed no reaction after 72 hours were observed for an additional six days but no further change was evident The unirradiated parent strain reduced the indicator in 8 hours and produced acid in 72 hours The two most striking variations evidenced in litmus milk were the failure to produce any observable reaction (strains 9 16 19 and 21) and the failure to reduce the indicator before producing acid (strains 3 13 15 17 and 18)

Each strain was tested for its ability to reduce nitrates to produce acetyl methylcarbinol and indol and the ability to lower pH sufficiently to give a positive methyl red test Equally turbid suspensions of each strain were prepared for the inocula and the tests were carried out as prescribed in Manual of Methods for Pure Culture Study of Bacteria All strains failed to produce indol Ten strains produced reactions identical with those of the parent strain Results are listed in Table III Those strains which differed from the parent only in the production of weak Voges Proskauer reactions all produced acid in litmus milk without preliminary reduction of indicator Strain number 3 behaved differently from the others by producing acid in litmus milk without preliminary reduction of indicator and by showing a negative Voges Proskauer reaction Strain number 16 differed by showing no reaction in litmus milk by producing a faintly positive methyl red reaction and by reducing nitrates The other strains which showed variation all gave negative reactions in litmus milk and in the four tests indicated in Table III

TABLE II

FERMENTATION REACTIONS OF IRRADIATED STRAINS OF *Listeria monocytogenes*

Carbon Compound	Strain						
	Parent 1 2 5 6 7 11 12 13 14 15 17 18 20	3	8	9	16	19	21
Arabinose	+	+	+	+	+	+	—
Dextrin	+	—	+	+	+	+	—
Dulcitol			—	—		—	—
Galactose		+			+		—
Glucose	+	+	+	+	+	+	—
Inositol	—	—	—		—	—	—
Inulin			—	—			—
Lactose	+	—		—	—		—
Mannitol	—	+	—	—	—	—	—
Melezitose	+		+		—	—	
Raffinose	+	+	+	+		+	—
Rhamnose	+	+	+		+	—	—
Salacin	+	+	+	—	+	—	—
Sucrose	+	—	+	+	—	+	
Xylose	+	—	+	—		+	

+ Production of acid — growth but no acid production

Pathogenesis

In order to determine whether any variations had occurred in the pathogenicity of these strains they were inoculated into embryonated chick eggs Each strain was grown for 48 hours on blood agar slopes which were then washed down with physiological saline These saline suspensions were adjusted to equal turbidities and varying dilutions were inoculated on the chorio allantois of 11 day old chick embryos Immediately following inoculation the most probable number of viable cells in each suspension was determined by the serial dilution method Each of five embryonated eggs was inoculated with 0 5 ml of each dilution of each suspension

TABLE III

ADDITIONAL BIOCHEMICAL REACTIONS OF VARIANTS OF *Listeria monocytogenes*

STRAIN	TEST			
	Nitrate	MR	VP	Indole
Parent 1 2 5 6 7 8 11 12 14 20		++++	++++	—
3 9 19 21	*	*	*	—*
13 15 17 18		++++	++	
16	++++	+	—	—

*=poor growth medium

TABLE IV

CHICK EMBRYOCIDAL ACTIVITY OF STRAINS OF *Listeria monocytogenes* IN TWO DAYS

STRAIN	MORTALITY RESULTING FROM THE INOCULATION OF INCREASING NUMBERS OF CELLS						
	5×10^{2}	5×10^{3}	5×10^{4}	5×10^{5}	5×10^{6}	5×10	5×10^{8}
Parent	0 10	0 10	6 10	10 10	10 10	10/10	
1	0 5	0 5	2 5	5 5	5 5		
2	1 5	3 5	5 5	5 5	5 5		
3	0 5	0 5	0 5	0 5	0 5	0 5	
5	0 5	1 5	1 5	3 5	5 5		
6	1 5	2 5	5 5	5			
7	2 5	3 5	5 5	5 5			
8	0 5	3 5	4 5	5 5			
9	0 5	0 5	0 5	0 5			
11	0/5	0 5	1 5	2 5	5 5		
12	0 5	1 5	3 5	4 5	5 5		
13	0 5	2 5	2 5	3 5	5 5		
14	0 5	3 5	3 5	5 5	5 5		
15	0 5	1 5	1 5	3 5	5 5		
16	0 5	0 5	0 5	0 5	0 5	0 5	0 5
17	0 5	0 5	2 5	3 5	5 5		
18	0 5	1 5	3 5	5 5	5 5		
19	0 5	0 5	0 5	0 5	0 5		
20	1 5	4 5	5 5	5 5	5 5		
21	0 5	0 5	0 5	0 5	0 5	0 5	

All 19 of the possible variants showed some slight variation but 3 strains showed a decrease in virulence which was beyond the range attributable to experimental error These results are recorded in Table IV

Fifty thousand viable cells of the parent strain killed three of the five embryos when first tested and two of the five when rechecked Five hundred thousand or more cells consistently produced 100 per cent mortality Fifty million viable cells of strains 3, 9, 16, 19 and 21 failed to kill any embryos Five hundred million viable cells of strain 16 produced no deaths in the chick embryos Virulence tests of all five variants and the parent culture were repeated in embryonated eggs and the same results were observed

Each strain which showed significant variation in virulence for the chick embryo was further tested for pathogenicity in mice Young female white mice were injected intraperitoneally with suspensions of the variants which had been standardized previously In some preliminary tests, the injection of thirty-nine million viable cells of the parent strain killed all of the mice within two days To assure that the inocula contained the same or larger numbers of variant cells than were present in a lethal dose of the parent strain, a dosage of fifty million viable cells was selected as the standard inoculum

Twenty mice were used for each strain and the results are recorded in Table V Whereas fifty million cells of the parent strain killed all of the mice before the fifth day a similar inoculum of each of the other strains resulted in only 5 10 per cent of deaths

TABLE V

MORTALITY IN 20 MICE INJECTED INTRAPERITONEALLY WITH 5×10^7 CELLS OF VARIANTS OF *Listeria monocytogenes* INDUCED WITH RADIOPHOSPHORUS

STRAIN	DEATHS ON DAY								PERCENT MORTALITY
	1	2	3	4	5	6	7	8	
Parent	4	9	6	1	0	0	0	0	100
3	0	1	0	0	0	0	0	0	5
9	0	0	0	1	0	0	0	0	5
16	1	0	0	0	0	0	0	0	5
19	1	0	0	0	0	0	0	0	5
21	2	0	0	0	0	0	0	0	10

Those mice which were inoculated with variant strains and which survived, were reinoculated six weeks later with a lethal dose of the parent strain to determine whether they were immune Each mouse was injected intraperitoneally with approximately 50 million viable cells Twenty mice which had not previously been inoculated were treated similarly and they served as the controls All of the mice died by the seventh day This indicates that any immunity against the parent strain which may have been conferred by the variant strains in the manner in which they were used, was of such an insignificant or transient nature as to be of little or no value for protection

DISCUSSION

Nineteen different strains were isolated from a suspension of *Listeria monocytogenes* after exposure to beta radiation Although these strains differed from the unirradiated parent strain in colony characteristics all were similar in general cell morphology, in motility, and in the possession of some common antigen

Most of the changes noted in this investigation as in the case with most studies of induced mutations in bacteria were changes involving loss of metabolic abilities and/or pathogenicity In two instances however, enzymatic activities which were either absent or completely suppressed in the parent strain were observed in the mutants, strain number 3 produced acid from mannitol and galactose and strain number 16 fermented galactose and reduced nitrates to nitrites It is conceivable that the apparent gain of enzymes as required by these reactions might be due to the loss of enzyme inhibitors No information to support or refute this hypothesis was obtained in the present investigation

The five strains of *L monocytogenes* which showed alteration in pathogenicity also failed to hemolyze horse blood, to ferment lactose and melezitose, and to produce strongly positive reactions in the methyl red and Voges-Proskauer tests In addition to the changes which were common to the five strains, each of these strains varied in some manner which was not common to the others or the parent It seems improbable that each physiologic alteration observed in this investigation was the result of a "hit" by a beta particle of a different sensitive region A more probable mechanism might be that in several instances either a single beta particle struck a center of genetic determinants which resulted in the simultaneous alteration of several physiologic characteristics or that a single determinant was altered which alone influenced several enzyme systems

Although administration of large inocula of the five non-virulent living cultures did not protect mice challenged six weeks later with the virulent parent culture one should not conclude that no protection can be afforded by this means A more detailed study with modified procedures should be made

SUMMARY

Cells of *Listeria monocytogenes* were suspended in a medium containing radioactive phosphorus at a total radiation level of approximately 45 000 equivalent roentgens over an eleven-day period At 24-hour intervals samples were removed and streaked on suitable media Nineteen strains were isolated which showed variations from the parent in their colonial characteristics Some of these also showed variations in physiological characteristics, in their antigenicity, and in their capacity to produce disease

Most of the physiological changes which were detected were indicated by the inability of the variant to produce metabolic reactions which the parent strain was capable of producing Two strains differed, however, in being able to produce biochemical reactions which the parent was unable to do Five strains exhibited a greatly decreased virulence for the chick embryo and the white mouse Heavy inocula of living cells of these strains, however, failed to protect mice when challenged with the parent strain six weeks later

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A COMPARISON OF STATURE, WEIGHT, AND HEAD MEASUREMENTS AMONG CATHOLIC, PROTESTANT, AND JEWISH STUDENTS[1]

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Over a period of six years records have been made of several genetic and anthropometric traits as they occur among students taking an introductory course in human heredity at Ohio State University The traits include blood groups M and N blood types, taste reaction to phenyl-thio-carbamide, handedness, hair color dermatoglyphics, pain threshold, stature, weight, head length and breadth National origin and religion have also been recorded The objectives of this project are to determine how effective cultural differences, such as nationality, geographic region and religion have been in preventing random mating, and to what extent biological variations may be associated with cultural differences

TABLE I

Group	No Ind	O	A	B	AB	% Fingers with Whorls	% Left Handedness
Jewish Students	330	35 45	40 30	15 17	8 48	38 32	15 84
Protestant Students	1 060	45 28	40 47	11 12	3 11	28 27	10 51
Jews New Orleans						42 7	
Jews Odessa	1,475	36 6	41 7	15 6	6 1		
Unselected Whites U S A	20,000	45 0	41 0	10 0	4 0		
Unselected Whites U S A	300					25 7	

No selection has been made in obtaining these data, all students registered in the course being required to give them Protestants comprise by far the largest proportion of the group, almost all of them being of British or Northwestern European origin Jews rank second in number, the great majority of them being of Russian and Central European origin Catholics of British and Northwestern European origin comprise the third group in order of size Several other groups including Negroes Italians, Greeks, and other small ones are as yet of insufficient size to warrant valid comparisons

Comparisons of Protestants and Jews in respect to the frequencies of the blood groups, dermatoglyphics, handedness and other traits have been reported in detail elsewhere (Rife 1948) and reveal certain differences of significance (Table I) Jews are characterized by a higher frequency of blood group antigen B than are the Protestants, but there is no difference in respect to the incidence of antigen A There are also significant differences in respect to the occurrence of whorls on finger-tips, and of left-handedness in the two populations Note the close correspondence between the blood group distributions of Jewish students and of Jews in

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[1] This paper was presented at the meeting of the American Society of Human Genetics in New York, December, 1949

[2] Department of Zoology and Entomology

Odessa Also note that the Jews in New Orleans differ from the unselected population in regard to whorls on finger-tips in much the same way as do Jewish students from Protestant students

Let us now consider comparisons of stature, weight, head length, and head width among Russian and Central European Jews British Protestants, Unclassified Protestants, and Catholics of British and Northwestern European descent Table II shows comparisons of stature and weight among females Differences are obvious, Jewish girls being the shortest, Catholics the tallest The difference between British Protestants and Unclassified Protestants is insignificant All of the other differences in stature are quite significant All four groups are quite similar in weight

Table III shows comparisons of stature and weight among males Here again we find obvious differences, Jews being the shortest and Catholics the tallest The differences between both classes of Protestants and Jews are highly significant Although Catholics are the tallest, the differences between them and the Protestants are not statistically significant The two types of Protestants are quite similar The trends among the males in stature are the same as those among the females Protestant and Jewish men show no real differences in weight but Catholic men are significantly heavier than the other groups

TABLE II

FEMALES

Group	Number	Stature	Number	Weight
Russian and Central European Jews	188	64 00 ± 0 16	186	125 84 ± 1 19
British Protestants	178	64 82 ± 0 17	175	122 56 ± 1 42
Unclassified Protestants	338	64 54 ± 0 13	316	123 26 ± 0 92
Unclassified Catholics	34	65 21 ± 0 42	35	123 85 ± 2 00

TABLE III

MALES

Group	Number	Stature*	Number	Weight*
Russian and Central European Jews	83	67 71 ± 0 30	83	149 96 ± 2 15
British Protestants	153	69 00 ± 0 22	153	151 24 ± 1 23
Unclassified Protestants	178	69 31 ± 0 17	177	151 16 ± 1 86
Unclassified Catholics	51	70 19 ± 0 35	51	159 50 ± 3 21

*Stature is recorded in inches, weight in pounds

We shall now consider head measurements (Table IV) Note that the trends in head length correspond with the trends we found in stature Jews have the shortest, Catholics the longest heads This is what one might predict, as stature and head length usually exhibit a positive correlation No differences are indicated between British and Unclassified Protestants All of the other differences in head length are statistically significant

In respect to head breadth, the greatest difference occurs between the two Protestant groups, the Unclassified Protestants having significantly broader heads None of the differences between Catholics, Protestants, and Jews are of statistical significance

Among males, we also find Jews have significantly shorter heads than do Protestants and Catholics (Table V) No significant differences are found between the two classes of Protestants, or between Protestants and Catholics

Head breadth corresponds closely to what was observed among females, the greatest difference being between the two classes of Protestants, the Unclassified Protestants having the broader heads No differences of significance are present between Jews, Protestants, and Catholics

To recapitulate, Jewish students are shorter in stature and head length than are Protestant and Catholic students, whereas Catholic students are taller and have greater head length than do the other groups No consistent differences in weight are apparent Unclassified European Protestants have broader heads than do British Protestants

TABLE IV**

FEMALES

Group	Number	Head Length	Number	Head Breadth
Russian and Central European Jews	74	178 79 ± 0 79	74	144 05 ± 0 57
British Protestants	62	181 30 ± 0 95	62	142 58 ± 0 76
Unclassified Protestants	109	181 56 ± 0 54	109	144 47 ± 0 54
Unclassified Catholics	27	187 00 ± 2 06	27	143 30 ± 1 36

**Head measurements were not taken during the first years of the project thus the numbers of individuals in Tables IV and V are considerably smaller than those shown in Tables I II, and III Measurements are in millimeters

TABLE V

MALES

Group	Number	Head Length	Number	Head Breadth
Russian and Central European Jews	28	187 80 ± 1 06	28	149 25 ± 1 51
British Protestants	60	193 30 ± 0 88	59	149 50 ± 0 67
Unclassified Protestants	73	192 27 ± 0 73	73	152 00 ± 0 66
Unclassified Catholics	38	192 87 ± 1 36	38	151 34 ± 1 25

These findings parallel those made earlier in respect to the blood groups handedness, dermatoglyphics and other traits Cultural differences are accompanied by biological differences presumably as the result of random drift in gene frequencies within each of the populations

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Animal Parasitology

This manuel with emphasis on the animal parasites of man is designed for the introductory course in general parasitology There are sections on the Platyhelminthes Acanthocephala Nemathelminthes Annelida Protozoa, and Arthropoda arranged in the order listed Miscellaneous information in various places includes a list of reference books bibliographic aids zoological nomenclature, calibration of the microscope construction and use of zoological keys and parasitological techniques There are numerous illustrations tables of data and an index The variety and amount of material in this guide and its arrangement allow the instructor much choice of what to cover in the classroom The author unlike so many authors of manuals must believe in learning and discovering by drawing because he frequently recommends that drawings be made and he has not included sketches for the student to label Unfortunately I do not have a first edition with which to compare this revision —*Carl Venard*

A Laboratory Manuel in Animal Parasitology, by H W Manter ix+121 pages Lithoprinted Spiral binding Burgess Publishing Company, Minneapolis 15 Revised edition 1950 Price $2 25

SOME PARASITES OF THE PRAIRIE MOLE, SCALOPUS AQUATICUS MACHRINUS (RAFINESQUE)[1]

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Fort Collins, Colorado

A parasitological examination of 42 specimens of prairie moles, *Scalopus aquaticus machrinus* (Rafinesque), taken in Perry, Champaign, and Franklin Counties, (Ohio) was undertaken to determine (1) the species of parasites of the host, (2) the percentage of infection of moles with each species of parasite, and (3) the mean incidence of infection of the host.

The moles were obtained by trapping with the harpoon type of mole trap (Olive, 1946), and all but one of the animals were dead when recovered from the trap. Parasites were removed from the moles as soon as possible after trapping and were preserved in alcohol.

ECTOPARASITES

Atricholelaps glasgowi

The mite, *Atricholelaps glasgowi* (Ewing), was recovered from 37 moles of both sexes, which represented an infection of 90.4%. The number of mites per host varied from 1-120 with a mean incidence of 11.4.

The most heavily infected mole was an immature male from which 120 mites were recovered. The mites had caused a dermatitis on the sides and back of this animal, and apparently had loosened the fur in the head and neck region. Much of the fur was matted with excreta of the mites. The general condition and appearance of this mole showed evidence of malnutrition. It seemed that the constant irritation by the mites had affected the feeding of the mole, since, at the time of examination, the stomach contained only digestive juices while the small intestine contained parts of several June beetle larvae and grass roots.

None of the other mite-infected moles showed any evidence of being affected. It is conceivable, however, that mites may become a limiting factor in a mole population since Olson and Dahms (1946) found that *Liponyssus bacoti*, the tropical rat mite, produced a fatal anemia in laboratory animals that had become accidentally infected with the mite.

These authors attributed the deaths to anemia rather than toxic products produced by the mite, since the hosts "demonstrated a progressive blanching of the skin, which could be attributed to a loss of blood."

Two specimens of *A. glasgowi* were sent to Dr. E. W. Baker of the U. S. National Museum for confirmation of the identification.

Siphonaptera

A single species of flea, *Ctenophthalmus pseudagyrtes* Baker, 1904 was recovered during this study.

This flea was found on 35 moles. This represented an infection of 83.3%. The number of fleas per host varied from 1-43 with a mean incidence of 7.

There was no evidence of any damage having been done to the host by this parasite.

Coleoptera

The one species of beetle, *Leptinus testaceus* Mueller 1817, recovered from 2 moles represented a percentage of infection of 4.7% with an incidence of 1.5.

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[1] The investigation was conducted at the Ohio State University, Columbus, Ohio.

The first 3 specimens of this beetle were taken from a live mole This is of particular interest since there is some controversy as to whether this beetle is a parasite Comstock (1933) stated Whether it (*L testaceus*) is a parasite or merely a guest has not been definitely determined Other entomologists suggested that the beetle might be feeding upon mites or dandruff scales found on the host Morphologically it could well be a parasite The dorso ventral flattening and the presence of a tarsal claw are suggestive of a parasitic mode of life It may be that the beetles left the moles very soon after death not remaining nearly so long as the other ectoparasitic forms It therefore might have been recovered more often if it had been possible to examine more living moles or to have obtained and examined the hosts very soon after death

ENDOPARASITES

Nematoda

The roundworm ***Physaloptera limbata*** Leidy 1856 was the only nematode found it was recovered from 6 moles both males and females being infected This represented an infection of 14 0% with a mean incidence of 1 3 Never more than two worms were found in a single host

Physaloptera limbata was found only in the stomach In cases where the worm was still attached it was usually near the pylorus These worms had no visible effect on the nutrition of the moles However there was evidence of a pathological condition resembling a mild gastritis in the stomach of one animal There was some ulceration of the stomach wall where a worm had apparently been attached at some previous time Monnig (1938) observed that ***Physaloptera*** occasionally change their site of attachment and leave wounds that continue to bleed The mucosa then may become inflamed with subsequent erosion of the epithelium

It would seem that secondary invaders might be of serious consequence if a great number of these worms were present

Acanthocephala

The spiney headed worm ***Moniliformis clarki*** (Ward 1917) Van Cleave 1924 occurred in 6 males representing both sexes of the host There was an infection of 14 2% From 1 10 worms per host were recovered representing a mean incidence of 1 9

In all the moles ***M clarki*** was attached to the mucosa of the small intestine These worms were located at distances varying from 10 centimeters to 30 centimeters from the pylorus There was a firm attachment to the intestinal wall and the head of the worm was always directed anteriorly The medium surrounding the parasites was semi liquid well digested food

The heaviest parasite burden of this worm was in a mole trapped in the city of Columbus Ohio Ten mature worms were attached between 35 to 37 centimeters from the pylorus Despite the fact that the intestine was distended and partially obstructed by the presence of these worms there was no evidence of any nutritional or pathological condition in the host There was however a slight mechanical injury caused by the attachment of the hooks of the proboscis

In general the incidence with ***M clarki*** was greatest in urban areas

Several specimens of ***M clarki*** were sent to Dr Asa C Chandler of Rice Institute for verification of the identification

Cestoidea

A single genus of tapeworm identified as ***Hymenolepis*** sp was taken from 2 moles The percentage of infection was 4 76% with an incidence of 1 4

In all only 3 tapeworms were recovered They were located high in the small intestine While in each case the scolex of each worm was free from the intestinal wall, there was no evidence of the worms having migrated Apparently the tapeworms had become detached from the intestinal wall upon death of the host

No apparent damage was caused by this tapeworm Since it is a relatively small worm, its nutritional requirements are undoubtedly negligible However, it is conceivable that if it were present in large numbers it might rob the host of sufficient food to produce the type of symptoms associated with tapeworm infection

DISCUSSION

The incidence of infection of the 42 moles examined during this investigation is strikingly low as compared with that of other small mammals in this area as shown by Katz, 1938, Ellison, 1942, Koutz, 1944 It is believed that there are two possible explanations for this condition First, the moles subterranean habitat forms a mechanical barrier against the parasites of surface dwelling animals and, therefore, the parasites are not shared Parasite ova voided in the feces of other animals would seldom find their way into the moles' feeding area Second, earthworms make up the greatest part of the moles' food, (Jackson 1915) Apparently earthworms do not serve as intermediate hosts of parasites of the mole

Despite the fact that the incidence of infection was low, the percentage of infection was extremely high (97 3%) There was only 1 mole in this survey that was entirely free from parasites Since this specimen had been dead about 4 hours, it is unlikely that external parasites would have left the body in this length of time This mole was trapped in an area from which other parasitized moles had been taken, thereby precluding the fact that the area was free of infestation It would seem that this specimen had failed to contact infective stages of parasites, or, having contacted them, was immune to infection

Again, since this was an immature mole, the absence of internal parasites might possibly be explained by the fact that the mole may not have been foraging long enough to have acquired an infection

It is more difficult to explain the absence of ectoparasites, since it is highly probable that they would have been acquired through contact with parasitized moles or from infected nests

SUMMARY

1 Six species of parasites were recovered from 42 moles

a The mite, *Atricholelaps glasgowi*, (Ewing) This mite was recovered from 90 4% of the hosts with a mean incidence of 11 4,

b The flea, *Ctenophthalmus pseudagyrtes* Baker, 1904 This occurred in 83 3% of the moles with a mean incidence of 7 0,

c The beetle, *Leptinus testaceus* Mueller 1817, was recovered from 4 76% of the hosts with an incidence of 1 5

d The roundworm, *Physaloptera limbata* Leidy, 1856, was recovered from 14 0% of the moles with a mean incidence of 1 3,

e The spiney-headed worm, *Moniliformis clarki* (Ward 1917), Van Cleave, 1924 This worm was taken from 14 2% of the moles with a mean incidence of 1 9,

f A tapeworm, *Hymenolepis* sp , was recovered from 4 7% of the hosts with an incidence of 1 4

2 The percentage of infection with all parasites was 97 3% whereas the incidence of infection was 17 3

3 In general the parasites had little effect on the condition of the host Only 2 pathological conditions could possibly be attributed to parasitism These were (1) a dermatitis probably caused by *A glasgowi*, and (2) gastritis which may have been caused by the attachment of *P limbata*

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WOLFFIA PAPULIFERA AND LEMNA MINIMA IN OHIO

MAURICE B WALTERS

Cleveland Ohio

In mid autumn of 1948 and again in the summer of 1949 the writer made collections of one of the Duckweed family which until recently has been considered one of quite rare occurrence—*Wolffia papulifera* Thompson Both Gray and Britton and Brown cite it as occurring only in Missouri Muenscher however in his Aquatic Plants of the United States calls it infrequent in the central states A recent article in the American Midland Naturalist (Wolffia papulifera in Florida D Jacobs Vol 42 p 110) announces its discovery in Florida and refers to it as apparently the only known occurrence outside of Missouri

However it has been collected in several other places as set forth in an article published some years ago which has just been brought to the writer s attention In Distribution and Flowering in Wolffia papulifera by W H Camp Ohio Journal of Science Vol 33 p 163 (May 1933) collections are listed from the following stations

Kennett Mo
Columbia Mo
Linn Co Kan
Mexico City Mex
Latonia Ky
Jackson Co Ohio
Southern Campeche Mex

The collections made by the writer were from ponds located in the Holden Arboretum in Lake County the species was growing in company with *Wolffia columbiana* Karst and *Spirodela polyrhiza* (L) Schleid

Collections were also made at about the same time of another species of the family which is apparently of infrequent occurrence or what is more likely generally overlooked—*Lemna minima* Phill It grew in a stagnant pool near the Chagrin River in Cuyahoga County the territory comprising a part of the Cleveland Metropolitan Park System It seems rather remarkable that there is no record to date of this latter species in the Ohio State University Herbarium

FIVE NEW ARKANSAS MILLIPEDS OF THE GENERA EURYMERODESMUS AND PARESMUS (XYSTODESMIDAE)

NELL B CAUSEY
Fayetteville Arkansas

The Arkansas millipedes described in this paper were collected by the author with the assistance of Dr David Causey The Illinois specimen was obtained through the kindness of Dr Milton W Sanderson Holotypes will be desposited in the collection of the Philadelphia Academy of Sciences paratypes will be retained by the author

During the summer of 1887 Charles H Bollman then a student at the University of Indiana collected myriapods in Arkansas incidental to his work on the Geological Survey of Arkansas[1] This work covered the region lying between the Ouachita River near Arkadelphia and the Indian Territory line near Ultima Thule in Sevier County The specimens which he identified as *Leptodesmus hispidipes* (Wood) and reported as abundant everywhere very common throughout the state[2] were undoubtedly various species now assigned to *Eurymerodesmus* and *Paresmus*

Genus **Eurymerodesmus** Brolemann

Tergites smooth keels moderately extended their margins thickened anterior angles rounded posterior angles from rounded to subacute pores lateral Femur of legs not spined Gonopods small telopodite a single unbranched slender blade with setae usually in rows Margin of gonopodal opening variously modified posteriorly and laterally with setose lobes The genotype is *E hispidipes* (Wood)

Eurymerodesmus hispidipes (Wood)

Figures 1 4

Polydesmus hispidipes Wood Proc Phila Acad Sci 1864 p 7 Trans Amer Phil So 1865 p 220 fig 48
Leptodesmus hispidipes Bollman Ent Amer IV 1888 p 2
Eurymerodesmus hispidipes Brolemann Mem Soc Zool Fr XIII 1900 p 101 pl 6 fig 32

In a collection of several hundred millipedes made by the Illinois Biological Survey there was only one specimen of *Eurymerodesmus hispidipes* Such relative scarcity in the type state makes publication of additional details of this species seem desirable Wood s (1865) description is as follows

> Olive brown immaculate anal scutum triangular with long hairs apex truncate and decurvate feet roughly hairy male appendages short robust their terminal spine moderate distally abruptly curvate densely pilose
>
> The side plates are rather short with their edges much thickened The head has its vertex strongly canaliculate Its anterior face is marked with two small punctiform impressions The lower border is not very strongly emarginate and is set with a fringe of short thick hairs The antennae are mostly dark colored scarcely at all clavate and coarsely pubescent The feet are rough with closely set stiff hairs The anal scutum is prolonged posteriorly so as to come almost to a blunt point The appendages of the male are short and thick Their terminal spine is slightly curved at its base thence is nearly straight save at its distal extremity where it is abruptly curved becoming nearly horizontal It is beset with very numerous long hairs The female appendages consist of a pair of short conoidal very pilose processes which have an opening along their inner edge Length 1⅛ inches
>
> Hab Illinois

Although my specimen is faded there are indications of the usual mid dorsal black line and the colored probably orange keels and margins around the collum and on the posterior edges of the tergites The olive pigment extends down the sides under the keels in triangular areas almost to the sternum The legs are darker distally Antennal joints are edged in black

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[1] Ann Rep Geol Sur Ark 1888
[2] Bull U S Nat Mus 1893 No 3 p 74

The process on the mandibular stipe has a longitudinal ridge on the anterior surface and an oblique ridge ectad Distally it is flattened and pigmented (Fig 1)

The coxal joint on the second pair of legs is unusual in that the anterior of the two conical tubercles is about twice as long as that observed in any other species, the posterior is the usual size (Fig 2)

Between the fourth, fifth and sixth pairs of legs there are low, rounded hirsute prominences The sternal processes between the eighth legs are shown in Fig 3 Similar but smaller processes are between the seventh legs The claws of the legs have a bulbous process at the base

In *situ* the telopodites of the gonopods lie parallel, the laterally pointing apices accuminate and slightly flattened Setae occur in three rows a short subterminal medial row and long lateral and ventral rows

The gonopodal opening is broadly oval emarginate as usual anteriorly, and with a row of long stiff setae on the anterior margin A pair of conspicuous quadrate lobes is set obliquely near the latero posterior angles of the opening (Fig 4) The lobes are raised about half the height of the first joint of the eighth pair of legs bear a few setae on their inner or posterior surfaces longer setae on the highest margin and numerous setae on the anterior or lateral surfaces Similar lobes occur in *E spectabilis*, *F bentonus*, and *F minimus* Loomis[8]

Length of male about 30 mm width 4 2 mm

Locality Illinois Dixon Springs Collected by Mr Phillip W Smith April 3, 1948

Eurymerodesmus bentonus, n sp

Figure 5

Tergites dark olive with mid dorsal black line, orange keels and orange bands of almost uniform width around collum and across posterior margins of tergites Anal tergite orange distally Antennae legs and venter cream Dark triangular areas extend down the sides of the prozonites almost to the legs, similar areas are shorter on the metazonites

Lateral margins of keels almost straight, posterior angles of fourteenth through nineteenth acute This is in contrast to *E hispidipes*, where the keels are well rounded laterally and the posterior angles of only the seventeenth through the nineteenth are acute This alone makes *bentonus* easily distinguished from *hispidipes*

Process on mandibular stipe of male about half as large as in *hispidipes*, but slightly pigmented, and without ridges

Coxal joint on second legs of male with the usual two conical tubercles, the anterior scarcely larger than the posterior Legs and sterna are less hirsute than in *hispidipes* Claws of male

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[8] Loomis, H F 1943, Jour Wash Acad Sci XXXIII, no 10 p 320, fig 2

EXPLANATION OF FIGURES

Fig 1 *Eurymerodesmus hispidipes* (Wood) Mandibular process left, anterior view, × 40

Fig 2 *Eurymerodesmus hispidipes* (Wood) Coxa of left second leg, ventral view

Fig 3 *Eurymerodesmus hispidipes* (Wood) Sternal processes between eighth legs of male, posterior view

Fig 4 *Eurymerodesmus hispidipes* (Wood) Telopodite of male gonopod, lobe of gonopodal opening, base of eighth leg, left side, anterio-lateral view

Fig 5 *Eurymerodesmus bentonus*, n sp Gonopodal opening (gonopods omitted), anterio ventral view

Fig 6 *Eurymerodesmus spectabilis*, n sp Seventh segment, anterio ventral view

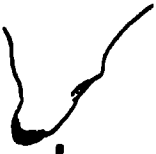
Fig 7 *Eurymerodesmus spectabilis*, n sp End of left telopodite, ectal view

Fig 8 *Eurymerodesmus plishneri*, n sp Gonopodal opening (gonopods omitted), anterior view

Fig 9 *Paresmus pulaski*, n sp Right gonopod, ventro lateral view

Fig 10 *Paresmus columbus* n sp Gonopodal opening (gonopods omitted), ventral view

Fig 11 *Paresmus columbus* n sp Right gonopod, ventral view *in situ*



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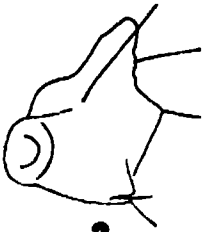

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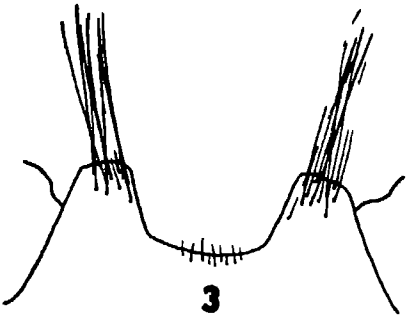

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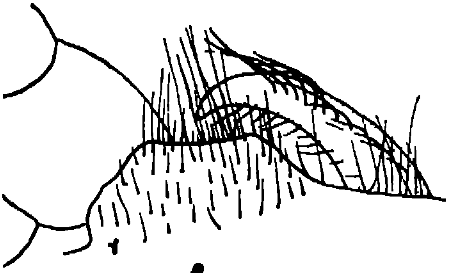

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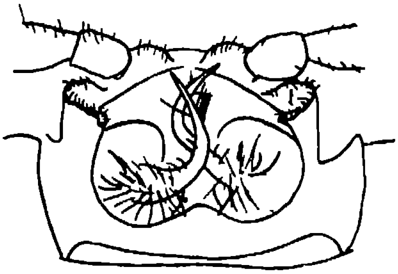

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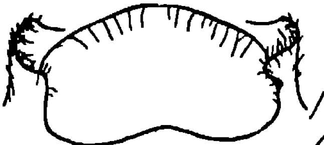

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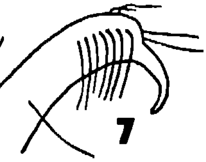

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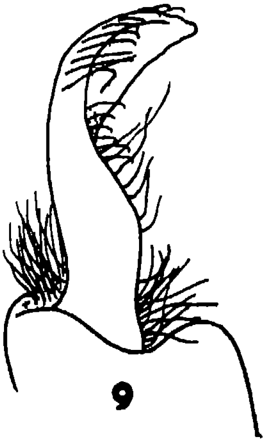

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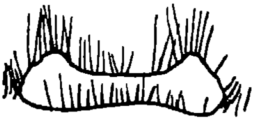

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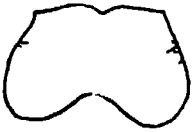

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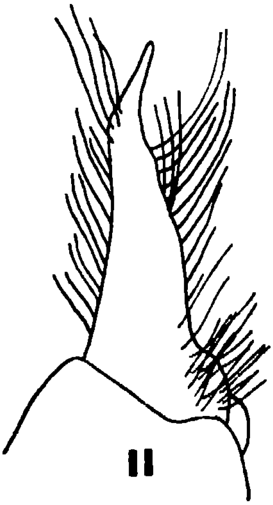

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finer and without the large bulbous base as in *hispidipes* Small hirsute prominences occur between the bases of legs four through seven The processes on the sternum between the eighth legs are not as high or as widely separated as in *hispidipes*

Gonopodal opening broadly oval slightly emarginate anteriorly (Fig 5) No setae occur on the anterior margin but they are present posteriorly and on the marginal lobes The lobes are quadrate as in *hispidipes* but they are nearer the margin and the highest point is the anterior corner Setae occur on the anterior and posterior surfaces of the lobes they are shorter than the setae on the lobes of *hispidipes* In *hispidipes* the setae on the free edge are long tending to give the lobe a triangular rather than a quadrate appearance

Telopodite of gonopod simple curved sharply distally The acute amber tip projects slightly beyond the posterior margin of the gonopodal opening *In situ* the telopodites of some males are parallel in others they are crossed and subparallel As in *hispidipes* there are three rows of setae on the telopodite a short subterminal medial row and two long rows one lateral and the other ventral

Length of male holotype 33 mm width 4 4 mm Length of female allotype 26 mm width 4 2 mm An intersex in the type collection was 27 mm long and 4 mm wide it had secondary sex characteristics of the female vulvae gonopods and gonopodal opening appeared normal

Locality Arkansas Benton County Monte Ne One male two females and the intersex were collected November 19 1949 at the base of a north sloping hillside on which oaks predominated Numerous other specimens were collected with *E plishneri* at Blue Spring Carroll County Arkansas October 29 1949 This site is also hardwood predominantly oak

Eurymerodesmus spectabilis, n sp

Figures 6 and 7

Tergites black and beige mottled some specimens black and orange the latter probably is the mature color prozonites usually darker than metazonites Intermittent mid dorsal black line Entire margin of collum the keels and distal part of twentieth segment orange Some specimens have an irregular orange band which does not reach the keels on the posterior region of the tergites in some specimens the orange band is replaced by four orange spots in some the color is so intense that at a distance they appear to be orange Antennae tan the sixth segment darkest Distal half of legs anal valves and scutum and sides of body dark mottled The mottled pigment extends far down near the attachment of the legs on the metazonites but less far on the prozonites Venter and proximal half of legs cream

Keels slightly rounded laterally but less so than in *hispidipes* posterior angles of fourteenth through nineteenth acute

Process on mandibular stipe less than half as long as in *hispidipes* not pigmented

Coxal joint of second legs of male without the usual two conical tubercles Female very sparsely hirsute ventrally male much less hirsute ventrally than in *hispidipes* Claws of male heavy and somewhat twisted the bulbous base not conspicuous Processes on the sternum between the eighth legs not as high or as widely separated as in *hispidipes* Sterna of legs three through seven without special processes

Gonopodal opening typically emarginate anteriorly and almost free of setae posteriorly the margin is difficult to determine since the opening reaches far back to the eighth sternum quadrate lobes arise from the posterio lateral margins flare widely and end behind the margin near the eighth legs their anterior corners are sharp and the anterior edges are folded back the free edges behind the anterior corners are black and short recurved setae occur on the edges and the medial surfaces (Fig 6)

Telopodite of gonopod simple sickle shaped end abruptly accuminate giving it a beak like appearance (Fig 7) two sparse rows of setae most of them on distal half of telopodite

Length of male holotype 21 mm width 3 mm Length of female allotype 22 mm width 3 2 mm

Locality Arkansas three miles east of Magnolia in a climax pine hardwood area Three males and six females were collected Dec 24 1949

Eurymerodesmus plishneri, n sp

Figure 8

Adults in full color with gray brown tergites intermittent mid dorsal black line Keels margin of collum posterior margins of tergites and distal part of twentieth tergite orange Orange margins on tergites usually wider medially almost giving the animal a trimaculate appearance and causing it to resemble *Auturus florus* with which it is usually found Antennae and distal half of legs dark gray Underparts and proximal half of legs cream Brown pigment extends far down sides almost to attachment of legs

Lateral margins of anterior and middle keels rounded but not as much as in *hispidipes* posterior angles of sixteenth through nineteenth acute

Process on mandibular stipe about size and shape of that in *hispidipes* but without ridges or pigmentation

Coxal joint of second legs of male with the usual two conical tuber les about equal in size and not conspicuous Claws of male thick not twisted but with bulbous base Sternal processes between eighth legs of male with space between them about equal to width of one of the processes inverted with long setae Sterna between legs four through seven setose lightly rounded remaining sterna between legs of male moderately setose Sterna of female almost glabrous

Gonopodal opening emarginate anteriorly and slightly emarginate posteriorly The margin bears posteriorly a pair of widely separated triangular lobes similar lobes occur in *E birdi* Chamberlin but the illustration given for that species[4] shows the lobes sharper and closer together than in *plishneri* The elevation of the margins is shown in Fig 8 The row of long setae across the anterior margin of the opening makes *plishneri* easily distinguished from *E bentonus* whose range it overlaps Setae are seen laterally on the margin which is pigmented there and out on the sternum Setae also occur on the margin of the lobes on their posterior surface and on the margin between the lobes

Telopodite of gonopods of male simple curved gently proximally and sharply distally Its setae are in three rows a short subterminal row of four or five setae and two rows which extend almost the full length of the telopodite the dorsal of these two rows is sparser

Length of male holotype 29 mm width 4 2 mm Length of female allotype 29 mm width 4 4 mm

Locality Arkansas Mount Kessler Fayetteville November 10 1949 Other collection sites in Washington County are Devil s Den State Park Mount Sequoyah Elkins and Eden s Bluff Blue Spring in Carroll County Oaks are dominant at all sites

I take pleasure in naming this species for Mr M J Plishner National Tuberculosis Association in recognition of his assistance

Genus **Paresmus** Chamberlin[5]

Agreeing in general with *Eurymerodesmus* The gonopods of the male are stouter throughout Lobes of gonopodal opening are continuous with margin not flaring widely laterally or between the legs as in *Eurymerodesmus*

Paresmus pulaski, n sp

Figure 9

Tergites dark olive with indistinct mid dorsal black line prozonites darker than metazonites Keels and distal part of anal tergite orange entire margin of collum and posterior margin of tergites orange On most of the metazonites the orange area is wider medially narrower laterally resulting in almost a trimaculate appearance Legs dark distally some spots of the dark pigment also on the sterna and proximal region of the legs which otherwise are cream Sides well mottled with pigment Antennae tan except for sixth segment which is brown

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[4] Chamberlin R V Ent News 1931 XLII no 4 pp 101–102 fig 8

[5] Chamberlin R V Bull Univ Utah vol 32 no 8 p 7 figs 18 and 19

Lateral margins of keels rounded, but not as much as in *hispidipes*, posterior angles of fourteenth through nineteenth acute.

Process on mandibular stipe of male about one-fourth longer than in *hispidipes*, laterad surface with low, broad prominence near base, no dark pigment

Coxal joint of second legs of male with the usual two conical tubercles, both rather sharp, but shorter than the genital process. Coxae of the third and fourth legs have a conical tubercle similar in shape and position to the anterior tubercle on the coxae of the second legs. Sterna between the legs of male hirsute Sternal processes between the eight legs are triangular, with relatively few setae, and widely separated Low, setose processes also occur between the legs of the fifth and sixth segments Claws not twisted

Gonopodal opening sharply emarginate anteriorly and broadly oval posteriorly When viewed laterally the margin rises from its lowest point on the anterior margin to a triangular lobe laterally, falls somewhat and then rises to another small triangular lobe near the base of the eighth leg The lobes are continuous with the margin and are not apparent as lobes when viewed ventrally All of the margin except the anterior is setose, and the lobes are setose on their outer surfaces

Male gonopods relatively large *In situ* the telopodites cross proximally then continue parallel, their dorsally curved ends reaching beyond and resting in the depression between the sternal processes between the eighth legs The ventral surface of the telopodite is convex, dorsally it is concave and there is a subterminal tooth on the dorsal surfcae (Fig 8), the distal third is bright amber color Setae occur in two rows on the telopodite one on the dorsal surface running almost the full length and the other latero ventral (*in situ*) on the distal half

Length of male holotype, 38 mm width 6 mm

Locality Arkansas, Pulaski County, three miles south of Sweet Home Two males were collected December 22, 1949 in an oak pine association

Paresmus columbus, n sp

Figures 10 and 11

In color, pattern and shape of keels similar to *P pulaski* Process on mandibular stipe without prominence at base, light brown

Coxal joint of second legs of male with the usual two conical tubercles, both rather sharp and slightly shorter than the genital process, which is somewhat truncated in this species. Small sternal setose processes are between the bases of all the legs from the fourth through the tenth, those between the eighth legs are largest, and the excavation between them is narrow, about half the width of one of the processes Sterna of female almost glabrous

Gonopodal opening emarginate both anteriorly and posteriorly and angular posterio-laterally (Fig 10) When viewed laterally the margin rises from its lowest point anteriorly to a triangular lobe laterally, the highest point of the margin is just anterior to the posterio-lateral angle of the gonopodal opening As in *P pulaski* the lobes are continuous with the margin and are not apparent as lobes when viewed ventrally The lobes are sparsely setose on their margins and lateral surfaces, their margins are pigmented The anterior and posterior margins of the gonopodal opening are glabrous

Male gonopods with the usual large coxa and small telopodite telopodite broad at base, accuminate distally, the tip curving dorsally (Fig 11) and overlapping Two long rows of setae distinguish this from the telopodite of *E creolus* Chamberlin[6] A longitudinal ridge is on the dorsal surface.

Length of male holotype, 35 mm, width 5 2 mm Length of female allotype, 32 mm, width 5 3 mm

Locality: Arkansas, three miles east of Magnolia in a climax pine-hardwood area Two males, two females, and several larvae of the sixth and seventh stadia were collected December 24, 1949 *E spectabilis* occurred at the same site

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[6] Chamberlin, R V 1942, Bull Uni Utah, vol 32, no 8, p 6, fig 16

EFFECT OF TEMPERATURE ON CATALASE ACTIVITY

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A search of the literature for an enzyme already quite well known which might be involved directly or indirectly in photosynthetic reactions suggested catalase. Catalase occurs in chloroplasts (Neish, Krossing), its activity in light grown corn seedlings is greater in green ones than in albino or in yellow ones (Eyster, 1950) and it is heat sensitive at much below the boiling point of water and at a temperature which it was thought might possibly explain the maximum temperature for photosynthesis.

Leaves exposed for one minute at 55° C. and above lost the ability both to form chlorophyll and to transform sugar into starch (Eyster, 1949). It was therefore of interest to study the thermal stability of catalase, and to determine the critical temperature at and above which destruction of catalase in corn seedling leaves occurs.

METHODS AND MATERIALS

Green and etiolated corn seedlings were grown and were subjected to a series of temperatures by means of a water bath. The temperatures employed were 50°C, 55°C, 60°C and 65°C, respectively. These temperatures were rigidly maintained within 1°C. The seedlings, about 14 days old, were cut off at the base, inverted and submerged in the water of the water bath for periods of 1 minute, 5 minutes, 10 minutes and 30 minutes, respectively.

Catalase activity was determined by the "catalase tube" method of Knott (1925) who measured the oxygen evolved from H_2O_2 at a constant temperature and with constant shaking for a 5-minute interval on one gram of macerated tissue. The temperature of the water bath was 27.5°C ± 0.5, and the catalase tube was shaken at a constant frequency of 140 revolutions per minute. The motor driven apparatus was improved by replacing the leather belt with chain and gears. This eliminated all variations due to slippage, and standardized the shaking considerably. Present too, were an ammeter and a voltmeter to measure electric D.C. current feeding into the motor. A rheostat was installed to regulate the current and thus have the motor maintain a constant speed of 140 r.p.m.

The sample was prepared by taking 1 gm. of umblemished fresh leaves. These were cut with scissors, disregarding size and shape, and placed in small mortar. To this was added 1 gm. U.S.P. precipitated $CaCO_3$, approximately 1 gm. reagent grade sea sand 60–120 mesh, and 1–2 ml. distilled water, depending upon dryness of sample. The mixture was ground to a fine paste (for about 7 minutes) using large pestle. This was washed with distilled H_2O into a small bottle. The total volume of water added was 25 ml. This was found to be a most convenient amount for rinsing mortar and pestle.

After shaking the mixture, 2 ml. portion was quickly withdrawn by use of a large orifice pipette and transferred to one arm of catalase tube. Five per cent hydrogen peroxide was used to which some $CaCO_3$ had been added and shaken. This mixture was kept stoppered and standing in ice water to keep the H_2O_2 at constant concentration by reducing decomposition to a minimum. 2 ml. of this was withdrawn by pipette and placed into the other arm of catalase tube. To get checks the ends did not need to be the same for sample and for H_2O_2 respectively. The charged catalase tube was carefully secured (level and in line with rod) to stopper on shaft and allowed to sit in the bath exactly 3 minutes to come to temperature of bath. Meanwhile water level in gas burette was adjusted and air exit clamped It was made certain that the catalase tube would fit well up on the stopper The motor and stopwatch were started simultaneously The gas burette reading was taken immediately at end of 5 minutes by adjusting the water level during the run

RESULTS AND DISCUSSION

The catalase measurements are given in Tables I and II Table III is a summary of Tables I and II A study of the data in these tables will reveal that 55°C was the temperature at and above which destruction of catalase occurred

TABLE I

CATALASE MEASUREMENTS ON ETIOLATED CORN SEEDLINGS SUBJECTED TO TEMPERATURES BETWEEN 50°C AND 65°C FOR PERIODS VARYING FROM ONE MIN TO THIRTY MIN

Catalase value is expressed as ml of O_2 in a 5 minute interval

	CATALASE ACTIVITY AFTER				
Temperature	1 min	5 min	10 min	30 min	Controls
50° C	9 20 9 30 9 20	9 22 9 15 9 20	9 10 9 00 9 10	8 80 8 80 8 80	9 22 9 20 9 28
Average	9 23*	9 19*	9 07*	8 80*	9 23*
55° C	8 70 8 60 8 60	8 42 8 42 8 40	8 20 8 18 8 22	1 95 1 98 2 02	8 28 8 30 8 28
Average	8 63*	8 41*	8 20*	1 98**	8 29**
60° C	7 10 7 08 7 02	0 80 0 72 0 75			
Average	7 07**	0 76**			
65° C	0 60 0 60 0 60				
Average	0 60**				

*Denotes comparability with proper control

A pretreatment of seedlings at 55°C for one minute brought about some destruction At 50° C there was no significant destruction except for pretreatment of green seedlings for 30 minutes A comparison of the temperature effects on etiolated and green seedlings of approximately same age showed the catalase in green ones to be slightly the more heat labile or destructible

Why is it that 55°C is the critical temperature above which chloroplast catalase is destroyed as well as above which chloroplasts lose their ability both to form chlorophyll and to transform sugar into starch? There are at least two plausible explanations Either (1) all of the chloroplast reactions are intimately tied up so that a disturbance to one affects the others also or (2) the various chloroplast reactions are accomplished by independent proteinaceous enzymes which are denatured by much the same conditions

Lantz (1927) reported that drying of corn seedlings at a temperature of 56°C reduced their catalase content and that a continuous temperature of 42°C during germination and growth decreased markedly the catalase content of corn seedlings In the potato tuber, Appleman (1910) found that the catalase was completely destroyed at 50°C The point of total destruction of catalase for most of the cases reported, however, ranges from 65 to 80°C (Miller, 1938)

It is well known that low temperature interfers with the utilization of nitrogen compounds and accounts for chlorosis in corn germinating on cool spring days To determine whether catalase formation may also be markedly reduced by low temperature during early growth of corn seedlings, the thermostat of the greenhouse was adjusted to maintain a temperature of 10°C This was done just as the green seedlings were pushing through the surface of the soil After 10 days time four pots of these corn seedlings were removed to a place indoors where the temperature was 25°C and where there was constant artificial illumination (15 ft candles) At this time the corn seedlings were 5–6 cm tall and were quite yellow in appearance The chlorophyll content remained quite low in ones remaining at 10°C, but the ones removed to 25°C became quite green in about one day The catalase activity (Table IV) was found to be quite high in the chlorotic ones grown at the low temperature, but did increase somewhat in the ones placed at 25°C These results are in general agreement with Lantz (1927) who found that there was a gradual accumulation of catalase in corn germinating and growing at 10° C, so that in 30 days the catalase content was nearly equal to that at 20 to 30°C

TABLE II

CATALASE MEASUREMENTS ON GREEN CORN SEEDLINGS SUBJECTED TO TEMPERATURES BETWEEN 50°C AND 60°C FOR PERIODS VARYING FROM ONE MINUTE TO THIRTY MINUTES

Catalase value is expressed as ml of O_2 in a 5-minute interval

Temperature	CATALASE ACTIVITY AFTER				
	1 min	5 min	10 min	30 min	Controls
50° C	8 80	8 75	9 85	7 95	8 60
	8 72	8 68	9 80	8 00	8 52
	8 75	8 52	9 72	7 90	8 45
		8 58			
Average	8 76*	8 63*	9 79**	7 95**	8 52*
55° C	9 52	7 55	4 30	1 02	10 20
	9 35	7 70	4 40	1 12	10 12
	9 28	7 72	4 30	1 05	10 20
Average	9 38**	7 66***	4 33***	1 06****	10 17**
60° C	2 90				10 02
	2 90				10 25
	2 88				10 02
Average	2 89****				10 02***
					10
					8 92
					8 88
					8 72
					8 84****

* Denotes comparability with proper control

While there is a remarkably close correlation in the way physical factors and chemical compounds affect catalase activity and photosynthesis, there is still no proof that the two are directly connected by a functional relationship

TABLE III

Summary of Effect of Temperature Treatments on Catalase Activity,
Based on Control = 100

Etiolated

Temperature	Catalase Activity After			
	1 min	5 min	10 min	30 min.
50° C	100	100	99	95
55° C	93 5	91	89	24
60° C	85	9		
65° C	7			

Green

Temperature	1 min	5 min	10 min	30 min
50° C	103	101	96	78
55° C	92	76	43	12
60° C	33			

TABLE IV

Effect of Temperature During Growing Period on Catalase Activity
Catalase value is expressed as milliliters of O_2 in a 5-minute interval

Age of Seedlings	Catalase Activity	
	Greenhouse 10° C	In Doors 25° C
Days		
14	9 25 (2)	
15	9 12 (2)	11 68 (2)
16	8 44 (2)	10 27 (2)
17	9 57 (2)	10 94 (2)

SUMMARY

1 Catalase in leaves of corn seedlings was destroyed by temperatures at or above 55°C

2 A comparison of the temperature effects on etiolated and green seedlings of approximately the same age showed the catalase in green ones to be slightly the more heat-labile or destructible

3 There seems to be a common thermal effect on catalase, starch synthesis enzyme, and chlorophyll synthesis enzyme 55°C is the critical temperature above which all three enzymes are destroyed A plausible explanation for this enzymatic destruction is that these enzymes are proteinaceous and are subject to thermal denaturation, as for example, egg albumin

4 The catalase activity was found to be quite high in chlorotic corn seedlings grown in greenhouse at 10°C, but did increase somewhat in ones placed at 25°C

5 There may be no direct functional connection between catalase activity and photosynthesis

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OCCURRENCE OF SCAPHIOPUS HOLBROOKII HOLBROOKII (HARLAN) IN ATHENS COUNTY, OHIO[1]

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A single individual of the spadefoot toad was collected near Athens, Ohio, May 24, 1943, by Dr H T Gier This specimen, an adult female, was reported in Copeia [2] This appears to be the only definite record for Ohio up to the present

Following a heavy rainstorm on June 1, 1950, Jack Jacobsen and the author heard an unfamiliar "whank" coming from a temporary pond near the Athens Airport We investigated the area and were able to collect one female specimen which was swimming in the water Others were heard but could not be located

On June 16, following another heavy rainstorm, the toads were again heard The temporary pond near the airfield was examined again, and several males were spotted singing They submerged when approached and none were collected At another temporary pond at the western end of the airfield a terrific din was set up by these toads By using a net, thirty-one (31) specimens were collected in less than half an hour There were many more present in the pond Eight pairs were taken in amplexus Tadpoles of the toads were also collected on June 29 These are the first tadpoles of the spadefoot collected in Ohio Specimens will be placed in the Zoology Department Collections at Ohio University, Athens, and in the Ohio State Museum, Columbus

Specimens 1 ♀—Near Athens, Ohio, May 24, 1943, H T Gier, Coll,
1 ♀—Athens (Airport) Ohio, June 1, 1950, Jacobsen & Spangler
8 ♂ 23 ♀—Athens (Airport), Ohio, June 16, 1950, Spangler
24 Tadpoles—Athens (Airport), Ohio, June 29, 1950, Spangler

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[1] Paper No 48 from the Department of Zoology, Ohio University, Athens, Ohio

[2] Gier, H T Copeia, 1945, (1) p 50

IS NATURAL SELECTION AN OUTWORN TERM?

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In the *Origin of Species* Darwin remarked that it was necessary to use such terms as natural selection and the struggle for existence in "a large and metaphorical sense including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny" (Darwin 19–? p 78) Some believed that these usages implied too much but Darwin hoped that with a little familiarity such superficial objections will be forgotten, since "Everyone knows what is meant and is implied by such metaphorical expressions" (p 99 ibid)

Notwithstanding his sanguine hopes, antagonism to the phrase natural selection, still finds expression in scientific journals (McAtee 1949) Consequently, there may be some excuse for describing briefly a few recent experiences which validate the use of natural selection or survival of the fittest in the Darwinian sense I do not propose a complete discussion of the subject, indeed completeness is not possible in view of the writer s limited opportunities Rather I shall describe briefly some observations which validate the concept of natural selection as Darwin employed the phrase I have already taken some pains to establish the breadth of Darwin's concepts Another quotation from the *Origin of Species* clearly indicates the core of the definition as employed by Darwin

"On the other hand we may feel sure that any variation in the least degree injurious would be rigidly destroyed This preservation of favorable individual differences and variations and the destruction of those which are injurious I have called Natural Selection or the Survival of the Fittest Variations neither useful nor injurious would not be affected by natural selection

It is a fundamental law of life to vary Zooolgists who have used chemicals experimentally to destroy insects and other forms of life quickly discover that a similar or identical dose yields variable results against different individuals of the same species Prior to the use of DDT as an insecticide the innate variations in resistance which houseflies, *Musca domestica*, might exhibit toward the compound doubtlessly existed but were neither useful nor injurious When that chemical was first used variations which are well known were encountered Therefore, houseflies offered abundant material to test natural selection as soon as DDT became a part of their usual environment Entomologists of Orlando Florida, were able to breed highly resistant flies by experimental breeding in the laboratory and artificial selection of the more resistant individuals These selected houseflies could withstand successfully much larger dosages of DDT than required to kill their ancestors (Lindquist and Wilson 1948) Experimentally the efficacy of selection was demonstrated

Notwithstanding the innate variability of houseflies toward the toxicity of DDT, that chemical was widely used to control the pests Suddenly the variations became of tremendous significance for the survival of the species For two or three years many American homes enjoyed practically fly-free summers But natural selection was approximately as successful among wild flies as experimental selection proved to be in the Orlando laboratory Particularly in southern California, where a large number of generations per year are possible, DDT resistant flies appeared At Bellflower, California, a strain of flies was found which required 300 times as much DDT to kill them as normal flies (March and Metcalf 1949), and the resistance was inherited as proved by breeding tests The same phenomena was observed in widely separated parts of this country As yet DDT resistance among houseflies is not known in Canada, possibly because of the short Canadian summer which does not permit as many generations per year Consequently, fewer Canadian flies have been exposed to DDT, and natural selection has only a reduced opportunity to exhibit its power

The case of the housefly and DDT-resistance is only one of many instances in which insects exposed in their natural state to a deleterious chemical have succumbed at first, but after several generations experience, they have developed resistance toward the chemical and have successfully returned near to their former abundance The individuals with variations tending toward chemical susceptibility were destroyed and the resistant forms were preserved Perhaps Darwin made an unfortunate choice when he inserted the word "rigid" in the first sentence of the last quotation, but this is largely a question of semantics rather than biology Certainly under a state of nature, selection has proved far more efficacious than many of us believed possible, and it seems fully as powerful as Darwin expected The results which are established by laboratory test and by numerous field observations conform closely to the Darwinian theory

A review of all instances where insects have acquired resistance to insecticides is unnecessary for purposes of this note However, the fever ticks of cattle, *Boophilus* spp illustrate some points not apparent in the instance of the housefly and DDT The U S Bureau of Animal Industry recommended the extermination of this tick in 1905 and later conducted a campaign intended to achieve the objective (Report of the Chief of the Bureau of Animal Industry 1905 and subsequently) As McAtee (1949) indicates, the elimination of the last tick proved difficult, but the Bureau persisted After more than forty years of effort the tick was eliminated from Continental United States, and the campaign was carried to outlying possessions

In other countries a policy of voluntary control was inaugurated Infested cattle were dipped in the same arsenical solutions employed for eradication in the United States but when the numbers of ticks were forced below levels of economic significance dipping ceased Whereas these arsenical dips used intensively over small area after small area exterminated the tick bit by bit, the same dips used extensively over large areas like Australia and South Africa gradually lost their efficacy (Whitnall and Brackford, 1947, 19th Ann Rept, 1945 Australia) Today in those countries where control rather than eradication was practiced, arsenic-resistent fever ticks are spreading rapidly, and cattlemen are turning to other agents to stop the successful recrudescence of the fever tick Where small numbers could be successfully exterminated by arsenical dips, large numbers and several generations through natural selection successfully resisted the same agent

Possibly the purist may insist that exposure of insects in a state of nature to insecticides is an artificial situation, and therefore, the phrase, natural selection, cannot be applied Nevertheless, the situation closely parallels some of the hypothetical examples described by Darwin Consequently, the results observed have some importance as a verification of Darwinism Using a broad but scarcely metaphorical definition we have seen natural selection operate

Only small organisms having several generations per year are able to expose a sufficient number of generations and of individuals to a deleterious factor to make possible a successful response Even with small animals as we have seen, a successful response may not be achieved if the agent is applied to small segments intensively and successively Furthermore, only economically important species like houseflies and cattle ticks are observed sufficiently closely over long periods of time, and over wide expanses of territory to ascertain if a successful response is being made Nevertheless, the first stages of this cycle are apparent all about us among other organisms

A few decades ago, a blight of chestnuts was accidentally introduced into the United States I was able to observe the effects of this parasite upon a magnificent and virgin stand of chestnuts in the Great Smoky Mountains during the summer of

1947 For hours I walked through a tangle of dog hobble and blackberries All around were large, dead chestnut trees, some prostrate, others still standing The trunk of one prostrate giant which lay across the trail was more than breast high, and after climbing onto it, I estimated by pacing that it was more than 60 feet to the lowest limb Along the trail I saw a very few infected but living individuals Most were mere suckers from surviving roots, but one was a tree with a trunk more than a foot in diameter Dead limbs and other lesions proved the tree was infected, yet burrs from the fall before littered the ground As McAtee states, it is difficult to exterminate the last survivor of a race Perhaps, after a passage of sufficient time a blight resistant chestnut will repopulate the steep slopes of the Great Smokies but for a slow breeding organism, like the chestnut, sufficient time means centuries, not a few years as with houseflies

Meanwhile we can only hope that the status of the chestnut will some day change from that of an unsuccessful, declining population to a successful, increasing species Nevertheless, we fear the worst We remember the great hordes of passenger pigeons, which formerly darkened American skies Whether the last survivors were destroyed by a natural predator, namely man, or whether as a parasitologist suspects, an introduced pathogen *Trichomonas gallinae* finished the work begun by man is unimportant Extermination is possible It occurred in the geological past, before man evolved, and it occurs today Perhaps the passenger pigeon foretells the fate of the chestnut or perhaps that tree will some day make a successful response to the blight

Natural selection may be, as McAtee (1949) insists a purely negative principle Nevertheless the results of this force, when coupled with the struggle for existence as Darwin closely united the two, may lead to positive results and the survival of a threatened and badly mauled species such as the chestnut or the fever tick

The instances where natural barriers have broken down and organisms have invaded new areas to the detriment of forms formerly successful in that area are too numerous to enumerate We may observe today the effects of the invasion of the upper Great Lakes by the sea lamprey The geological record shows the effects upon the native fauna of the invasion of South America by northern mammals at a late period Indeed the geology of that continent influenced markedly the character of the *Origin of Species* The generalizations Darwin formed from observations in that land and elsewhere might have enabled a keen analyst to predict the results of our modern uses of insecticides It is very difficult to formulate terms or phrases which will describe these broad principles without in some degree giving offense to someone's semantic preconception However, Darwin s terms such as "struggle for existence," and "natural selection," suggest the relationships as they actually exist Possible "survival of the fittest" should be discarded for reasons of an emotional nature, but the others may be used in a large and almost metaphorical sense as Darwin intended, at least until better terms are formulated

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THE MIXED BLOOD RACIAL STRAIN OF CARMEL OHIO AND MAGOFFIN COUNTY KENTUCKY

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A number of population groups of dark skinned peoples recognized as socially distinct in rural localities of eastern United States are commonly assumed to be tri racial mixed from white Negro and Indian ancestors A small example of such a group is mentioned by *The Ohio Guide* (1) as living in the vicinity of Carmel in Highland County Aside from another small mixed blood settlement of very different circumstances in Darke County this group near Carmel is probably the only one to be found rooted in Ohio

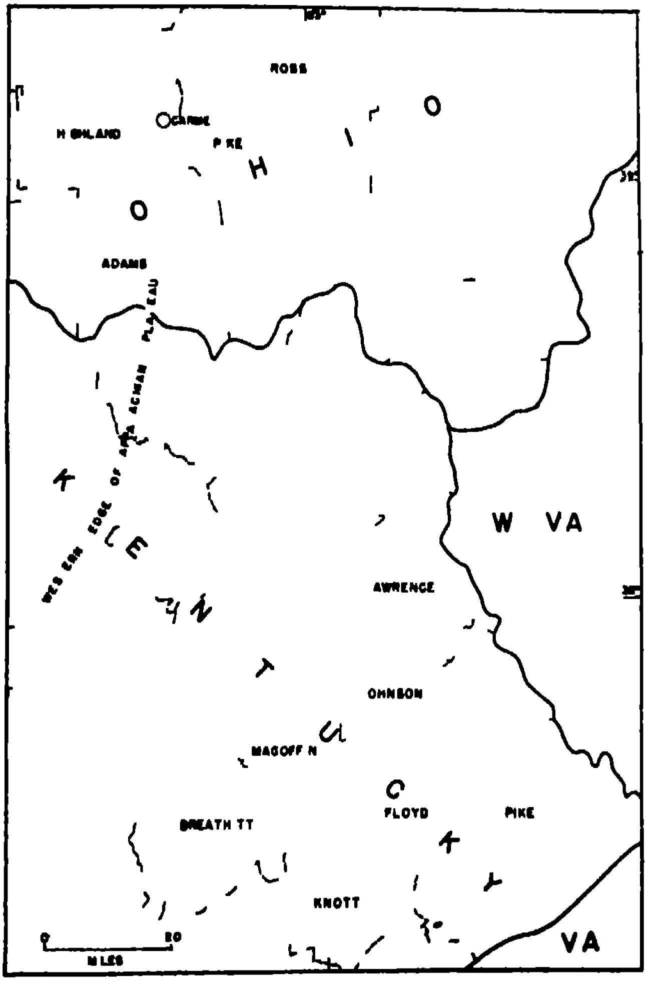

FIG 1 Location map showing Carmel and Magoffin County

MIXED-BLOODS OF CARMEL

Carmel is a cross-roads hamlet based on a school, a church, and a country store Its location on the margin of the Till Plains, half surrounded by the wooded hills which mark the western edge of the Appalachian Plateau, is probably significant for the phenomenon which brings it this notice (figs 1 and 2)

The "half-breeds" or "Carmel Indians," as they are locally identified, are well known to the farmers of the vicinity, who, on the surface at least, accept good-naturedly the claim of the former to Indian ancestry Privately the question of Negro blood also may be raised Most of the older residents think that both are present and can name families or individuals who they think illustrated each type in the days before the mixing was so thorough The group look mixed, a few of them are nearly white, but most are identifiable by their brown or tan skin, many of them have curly black hair, and many have straight black hair Few, if any, really look like Indians, but identifying negroid features are not usual I consider it likely that Indian and Negro mixtures are both present on the basis that the degree of pigmentation in most of the people otherwise seems inconsistent with their general lack of negroid features (figs 3, 4, and 5)

FIG 2 The Waverly cuesta, western edge of the Appalachian Plateau Carmel lies at the foot of the hills on the left

The surnames of the members of this group are, with few exceptions, Gibson (Gipson), Nichols, and Perkins One or two other names have recently been added to the group by marriage Some of the Gipsons aver that the Gibsons have a trace of Negro blood In the summer of 1947 their number was determined to be at least 150, the population is said to have been somewhat larger in times past

These half-breeds usually reside in the hilly part of the Carmel environs Their homes are characteristically one-room shacks, a few of which are mud-chinked log cabins Some live as tenants on farms of the vicinity, in recent years a few have been able to purchase small tracts of land Traditionally they have been squatters, taking advantage of the unused hill land, tolerated by the owners as long as they seemed useful to the community as a source of farm labor A group of shacks occupied in one of the hollows is known as "Pocahontas Row"

In addition to sporadic work on farms, the Carmelites have supported themselves in various ways, partly from the hill lands where they hunt squirrels and ground-hogs (in season or out) for food, dig ginseng (*Panax quinquefolium*) and yellowroot (*Hydrastis canadensis*) for sale to herb houses through the local stores, and obtain wood for fuel and building Most of them keep chickens, which run in and out of the houses freely in summer, and some keep pigs Many cultivate small garden patches and occasionally one may have the land for a corn crop Petty theft particularly of feed grains has been attributed to them One family apparently not connected with the others has made a business of weaving and selling baskets Various public welfare payments have contributed to their support in recent years to the great irritation of their neighbors

Fig 3 Carmel family and house

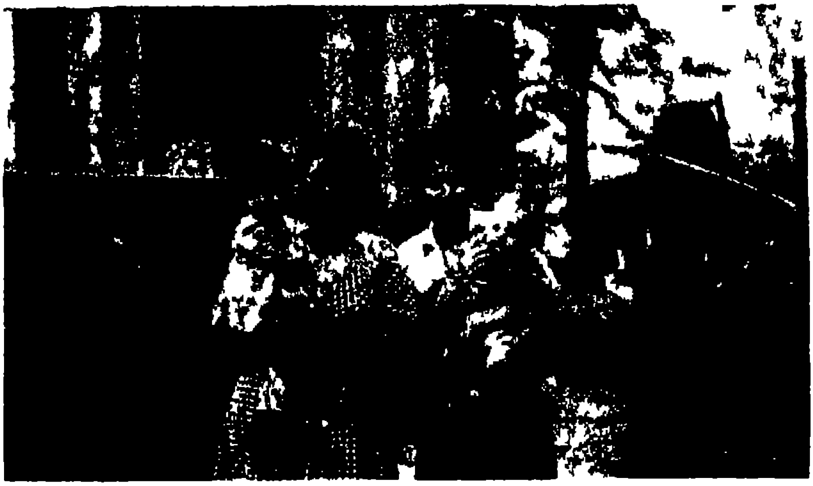

Fig 4 Carmel family

In cultural terms the Carmel Indians represent an intrusion of the Kentucky Mountains into the Middle West The country people are quick to point out their differences in language—the prevalence of non-grammatical phrases and the use of old forms such as "holp" and "poke," "hit" is common for "it," and "lamp oil" is the phrase for kerosene The laundry is boiled in the outdoor kettle, and the more industrious string their "shuck beans" on the porch to dry out and produce a supply of food for winter (fig 6) In their numerous progeny and in their general family relations they also correspond closely to the rural Ohioan's concept of Kentuckians

The Carmelites are considered extremely shiftless by their neighbors, it is the characteristic belief (perhaps worthy of study itself) that nothing can be done for them which will permanently raise their low standards This impression of an ambitionless existence is supported by direct observation of some of the people

FIG 5 Carmel children of closely related families The light and dark types stand in striking contrast

The visitor is likely to find most of the residents of a house in a sitting or reclining position One with whom I talked had planned a tobacco crop, but had only poor excuses for not having started it by mid-June Malnutrition might well provide a physiological basis for the continuance of this inertia, which few incentives seem to overcome

The cultural peculiarities are not needed for determining the source of the mixed breeds, for it is common knowledge in the community that Magoffin County, Kentucky, is their original home Many of the present residents were born in Magoffin County, and they return there frequently for visits, some wintering in Kentucky regularly Lack of economic opportunity was apparently the reason for their leaving Magoffin County, and, indeed, some of the Carmel people move on north for seasonal employment in the Scioto onion marshes or work on railroad gangs Carmel, however, has the aspect of home to many of these people, and they are likely to come back again On returning to Carmel, they may move into vacant shacks or, finding the old homes torn down, move in with neighbors It is a standing joke in the community that one never knows how many people he may find living in one of the shacks

The termination of their original northward movement at Carmel is probably a matter of chance, but, once arrived, they found an ecological niche which offered them the needed sources of support The juxtaposition of reasonably good agricultural land and steep hill land replete with the hollows of an irregular boundary seems to have offered in one locality farms prosperous enough to provide employment and a refuge for residence locations their shacks are sheltered from the winds of the open plains and from easy observation, they are off the arable land whose use the farmer would refuse, but accessible to building material, fuel, food, and a source of supplementary cash The farmer in his turn gained a source of labor which would not only not demand high wages, but may not have even desired steady work

Fig 6 Shuck beans strung up to dry on porch in Tennessee This practice is also reported at Carmel

MIXED-BLOODS OF MAGOFFIN COUNTY

Investigation of Magoffin County as the source of the Carmel people soon disclosed that it too, with adjacent sections of Floyd County, is the home of a mixed group Magoffin is a typical Kentucky Mountain County with little to distinguish it from many others The better farming land is in the narrow valleys, the poorer on the lower slopes of the hills As in most of the mountain counties, Negroes are almost completely lacking

The mixed-bloods are accepted without serious question as to origin or status Many of them own farms, some of the hillside variety, others of somewhat better nature In Magoffin County their ownership of submarginal land is traditional, whereas in Carmel it is new They are usually considered to be part Indian, though a few people prefer to call it Negro, and they have been famous for their large families and their ability to keep them going without apparent means of support Many have also been farm laborers Their habits of ridge farming and of hunting with their numerous dogs are usually attributed to their Indian blood

Most of the Magoffin County mixed-bloods who are recognizable today have straight black hair, rarely wavy The suggestion of Indian blood is more easily accepted than is the case with any other such group I have visited (figs 7 and 8) Intermarriage with unmixed whites is not unusual at the present

In view of the derivation of the Carmel group from Magoffin County, two curious differences between the two groups met my observation The Magoffin mixed-bloods are generally lighter in skin color, and their residence in the area is more dispersed There are, perhaps, 200 of the mixed-bloods in Magoffin County now, they are considered to be fewer in number and less Indian-like in appearance than in the earlier days recalled by old-timers The surnames found among the Carmel group are prominent and are said to belong exclusively to the mixed-bloods in Magoffin County, Cole, Hale, Harmon, and Barnett are also characteristic surnames

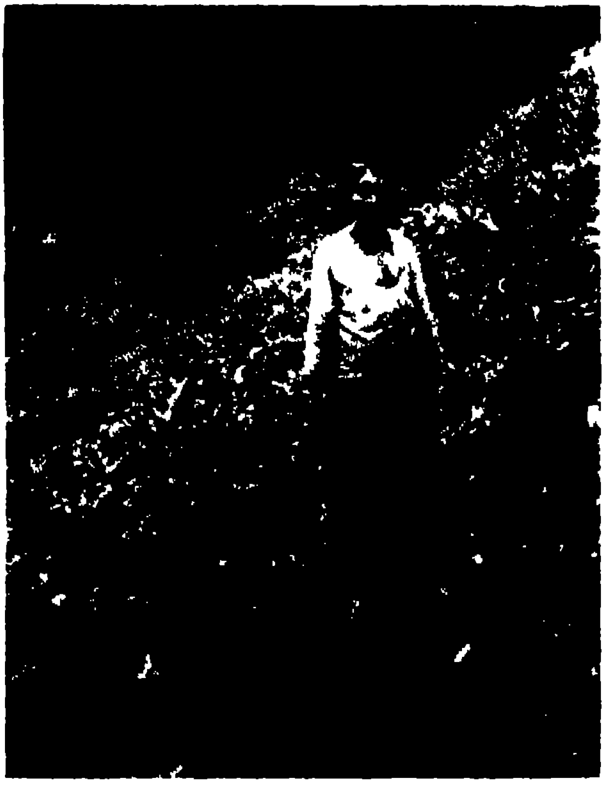

FIG 7 Member of the Magoffin County group interrupted while interplanting the corn with beans She claims to be three-fourths Cherokee and appears to be partially correct

Big Lick, Middle Creek, and Mason Creek (fig 9) are mentioned as residence localities for the mixed-bloods, but the Big Lick, in reality a short narrow branch, is the only concentration of them It contains six houses and some very poor sites for farms, but a map of 1915 showed 16 houses in addition to the school (2) A former teacher at the school said that it had 68 pupils in 1925, some of them grown, but none advanced beyond the third grade, the school's enrollment of 23 in 1947, over half of whom actually lived on the Big Lick, also indicated the population decrease Within the last 40 years the people have been converted to the Holiness sect, which has erected a church at the mouth of the stream This area was dominated by the Cole family and is yet known as the "Cole Nation"

The conversation of the Magoffin County mixed-bloods confirms the conclusion that the different families in scattered parts of the country are closely related Some of this group also migrate to the onion marshes and other places where seasonal employment may be obtained

FIG 8 The two girls are granddaughters of the woman in Fig 7 The bark is from Indian arwood which the mother digs

HISTORY OF THE MIXED-BLOODS

Some members of both the Carmel and Magoffin County groups claim Cherokee Indian ancestry and refer to forebears who came from "Old Virginia" or Tennessee The story of their origin told by white residents of Carmel involves settlement nearby of a slave-holding family from Virginia shortly before the Civil War It asserts that the slaves, who were named Nichols, were freed by their move into Ohio, but continued to live in the community and married the later immigrants from Kentucky, who bore the names of Gibson and Perkins On the other hand a county historian (3), who has long been interested in the backward peoples of the locality, thinks that Shawnee Indians surviving in the area formed the nucleus of the group and that they have only recently mixed with the immigrants from Magoffin County

The census records (4) support neither of the last two accounts The first trace of these mixed people at Carmel appears in the 1870 schedules and shows that all of them had ties with Magoffin County Five families listed as mulatto in Brush Creek Township (Carmel) included three Gibsons, a Nichols, and a Perkins Some of the older members of these families were born in Virginia and Tennessee In 1880 the count of these families was Nichols 10, Perkins 2, Gibson 1, all the family heads were born in Kentucky As a matter of interest, the census of 1890 (5) recorded more Indians resident in Highland County than in any other Ohio County, the number was 22 and all were in Brush Creek Township

Very few marriages involving members of this group were recorded in the Highland County records before 1900 it is said that they seldom troubled to legalize their marriages until very recently Between 1900 and 1946, 46 marriages recorded in Highland County involved persons from the Carmel group as identified by name (or name of parents) and residence or birth in Carmel or Magoffin County, both parties to 24 of these marriages were so identified In other words, over two-thirds of the mixed-bloods whose marriages were so recorded and identified married other members of the group This rate of in-marriage, indicated also by the paucity of surnames, is surprisingly high for a small group removed from its original home At least a third of the parties to these marriages were unable to sign their names

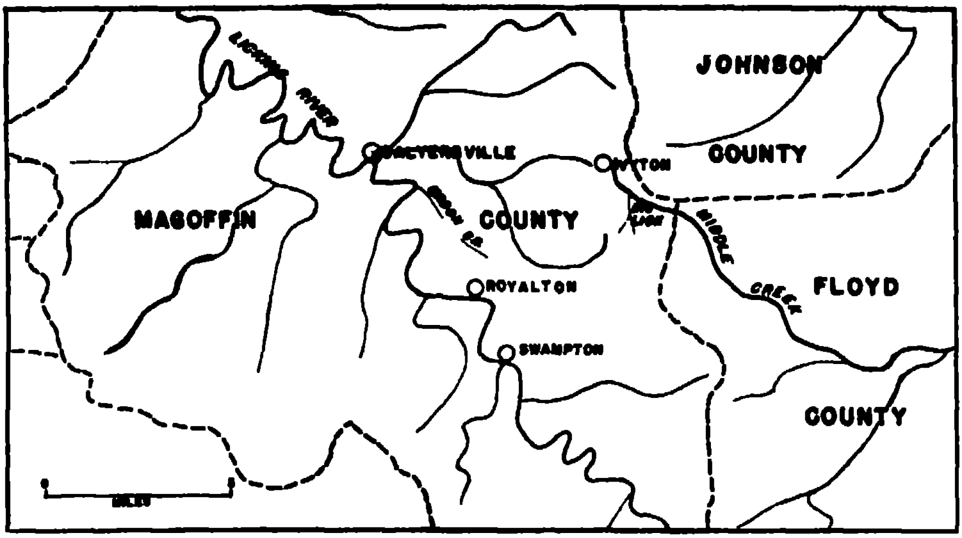

Fig 9 Location map of Magoffin County area

The census schedules indicate that some ancestors of this mixed group were in Floyd County (which then included Magoffin) by 1810 In the census of 1820 several of these families were listed as free colored persons In 1850 and subsequent years members of the same group of people were variously listed as both white and mulatto Their numbers increase with successive censuses It is evident that this racial mixture is a matter of long standing with these people and that the first of their ancestors to settle in Kentucky were mixed themselves Virginia, Tennessee, and North Carolina appear in the census schedules as states of birth of the early settlers

The racial distinctions indicated by the censuses may have played a part in the selection of emigrants from Magoffin County The darker-skinned members of the group may have found fewer opportunities at home and may have played a disproportionate part in the movement Another possible explanation of the darker complexion found among the people at Carmel is the greater opportunity available there for marriage with Negroes

It is a matter of considerable interest that the records indicate with reasonable probability a connection between the Magoffin County mixed-bloods and the better known and more numerous Melungeons of eastern Tennessee and southwest

Virginia This case rests on the identification of mixed-bloods in the records by two conservative properties their surnames and their classification as free persons of color or mulattoes this method is considered valid because of the facts that the census records list few free persons of color aside from those bearing the names of present interest and that these names are usually grouped when they do appear

TABLE I

Names of Melungeons and Magoffin County Mixed Bloods

Recognized Melungeon Names Today		Recognized Names of Magoffin County Group
Collins	Williams	Gibson
Gibson	Barnett (?)	Perkins
Goins	Freeman	Nichols
Mullins	Sexton	Cole
Moore	Bolen	Collins (?)
Minor	Bell	Hale
Delph	Mize	Harmon
		Barnett

TABLE II

Selected Census Data on Free Colored Families Bearing Names Common among the Melungeons and Magoffin County Mixed Bloods

County	State	Name	Number of Families	Year State of Origin (if not Ky given only after 1840)
Known Melungeon localities				
Wilkes	N C	Nichols	1	1790
Hawkins	Tenn	Hale	2	1830
		Cola	1	1830
		Moseley	2	1830
Claiborne	Tenn	Cole	1	1830
Cocke	Tenn	Nichols	5	1840
Letcher	Ky	Nicholas	1	1850 Tenn
		Perkins	1	1860 Tenn
Possible Melungeon locality				
Campbell	Tenn	Perkins	1	1830
Counties between Melungeon and Magoffin areas				
Pike	Ky	Moseley	1	1830
		Gipson	2	1830
		Collins	1	1860
Harlan	Ky	Cole	1 (Indian)	1860 Va
Knox	Ky	Harmon	1	1860
		Goins	1	1860
		Goings	1	1860
Magoffin Floyd area				
Floyd	Ky	Moore	2	1850 N C
		Mosley	1	1850 Tenn
		Moore	8	1870 N C Ky Va
		Mosley	1	

(In 1947 both Floyd and Knott Counties Ky had people named Moseley who are considered to have Indian blood)

The significant name data from the census records are summarized in Tables I and II

Gibson is now the only important name shared by Melungeons and Carmel Magoffin mixed bloods All other common surnames of Magoffin County people may be identified among free colored people who the census schedules indicate have lived in association with Melungeons Free colored persons bearing two Melungeon names (Collins Moore) have lived in association with the ancestors of the Magoffin County people and the name of another eastern Kentucky family (Moseley) now rumored to possess Indian blood is associated in the records with both the Melungeons and the Magoffin County people The counties containing these people form a chain which is continuous between Magoffin County and the Melungeon home area which centers in Hancock County (formerly included in Hawkins) Tennessee The names of a few individuals in census and county records also lend weight to these conclusions

CONCLUSIONS

These mixed blood groups then appear as by products of two larger population movements one westward the other northward Mixed blood peoples from the Southern Seaboard states moved westward with the stream concentrating in certain localities The Magoffin County group was formed by branches of this stream from the east as well as northward moving offshoots of the Melungeons The original populations were very small but they increased by natural reproduction the mixed bloods were distinguishable from other mountain residents only by their names color and reputation Beginning about the time of the Civil War Magoffin County served in turn as the jumping off place for a move across the Ohio The latter move brought to Carmel a mixed blood population entrained by the general emigration from overcrowded parts of Kentucky

REFERENCES

(1) Writers Program Ohio The Ohio Guide New York Oxford University Press 1940 p 509

(2) U S G S Topographic Sheet Prestonburg Ky 1915

(3) Violet Morgan Folklore of Highland County Greenfield Ohio Greenfield Printing and Publishing Co 1946 pp 28 30

(4) Original schedules of undestroyed U S censuses up to and including that of 1870 are filed by year state and county in the U S National Archives Washington D C The 1880 census is available on microfilm at the D A R library Washington

(5) Eleventh Census of the United States Report on Indians Taxed and Indians Not Taxed in the United States Washington U S Government Printing Office 1894 p 527

FIFTIETH ANNIVERSARY

OF

THE OHIO JOURNAL OF SCIENCE

In November 1900 the first issue of the Ohio Naturalist was published The Ohio Naturalist later became the Ohio Journal of Science The publication of this issue marks a half century of service to science

NEW SPECIES OF ERYTHRONEURA OF THE MACULATA GROUP

(HOMOPTERA CICADELLIDAE)

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The species described below all occur in Illinois with additional records for some from the Great Smoky Mountains region In working out the identity of these species there arose a need for clarification of the definition of the Maculata Group

In current and past North American literature the genus *Erythroneura* has been divided into a series of groups on the basis of wing venation There has been considerable difference of opinion among various authors as to the number and limits of these groups due in part to the variability of the venational characters even within the same species and in part to the admitted arbitrary nature of the groupings A much sounder basis for subdividing the genus using characters of the male genitalia has been advocated by Ribaut and other European authors These are summarized by Ribaut 1936 (Faune de France 31 Typhlocybidae)

A survey of genitalic types of the Maculata Group shows that two major groupings are represented One contains only the species *illinoiensis* (Gillette) with its two color forms *regalis* Beamer and *spectra* McAtee This species can be placed satisfactorily in Ribaut s Fasciaticollis Group characterized by the evenly convex foot of the style and the short simple pygofer hook The second group includes all the other species placed in the Maculata Group by DeLong and Knull 1945 and Oman 1949 in their check lists of the North American forms it apparently is not represented in the European fauna at least as reported by Ribaut The Maculata Group may be characterized briefly as follows style with a posterior point or a concave apical margin pygofer hook straight or elongate never short and hooklike simple in most species but cleft to base in some in which case the base is a single stalk fig 1 closely associated with the base of the pygofer hook is a sclerotized but undarkened short rod which usually has the appearance of a basal spur figs 1 10 This is the largest known group in the genus containing about 130 known species

Erythroneura millsi n sp

This species is closely related to *unica* Beamer differing in the deeper cleft and longer upper arm of the pygofer hook and the shallower phalicata

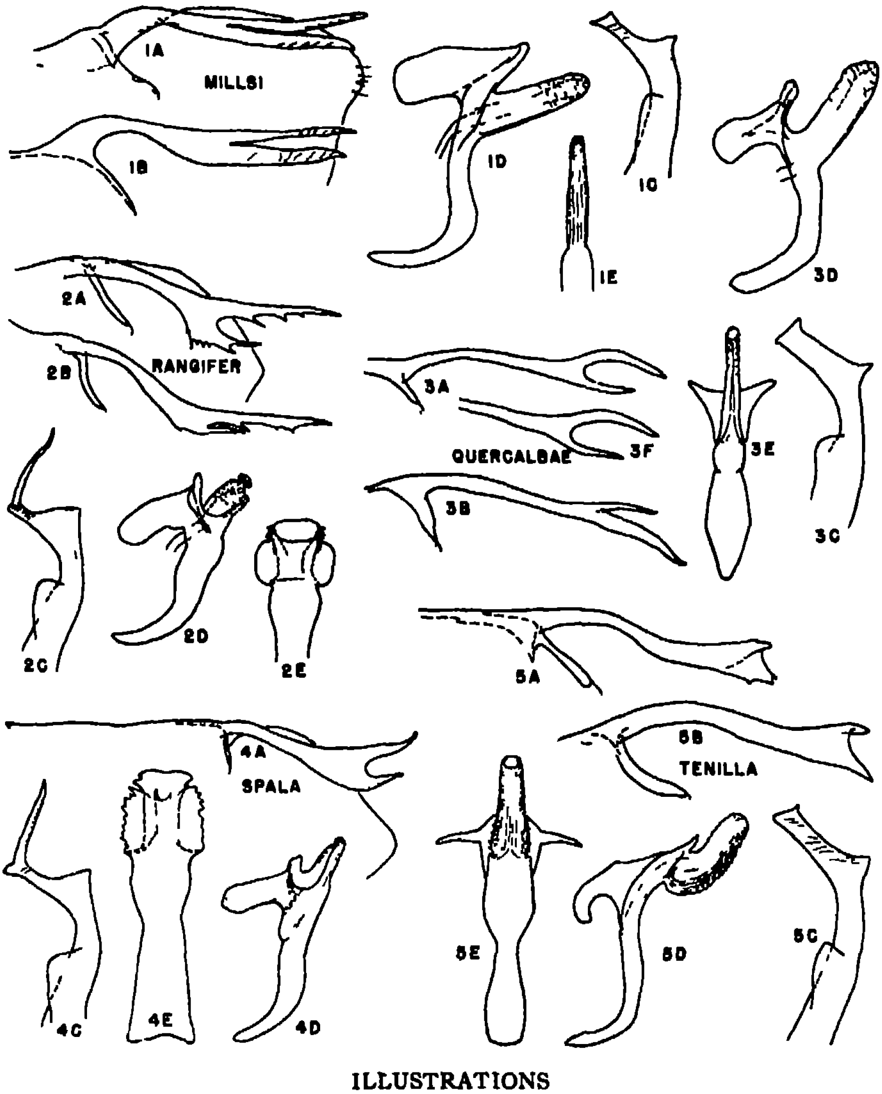
Male—Length 2 9 mm Ground color whitish cream head with yellowish open diamond shaped mark pronotum with yellowish U shaped mark elytra with large pale orange anchor mark and apical spot on clavus irregular orange marks making a zig zag down corium a pink border along the apical crossveins and associated veins and a black spot in base of cell M_4

Genitalia as in fig 1 Pygofer hook left slightly more than halfway to base the two arms subequal in length the dorsal one slightly stouter the base is narrow curved and turned and expands into a broader portion before the base of the cleft this condition being especially apparent from dorsal view fig 1*B* Style with foot oblique to base with sharp projecting heel sharp anterior point and with the posterior point represented by only a sharp angulation Aedeagus with phalicata situated just above the midline phalicata with lateral aspect long moderately deep nearly parallel sided and rounded at apex and with posterio ventral aspect narrow parallel sided and with a very narrow lateral flange from base to well beyond the midpoint

Holotype, male, Gibsonia, Ill , July 14, 1948, on *Quercus stellata*, Mills and Ross (INHS) This specimen was taken in company with several similarly marked females from an isolated tree and may represent a host association

Erythroneura rangifer n sp

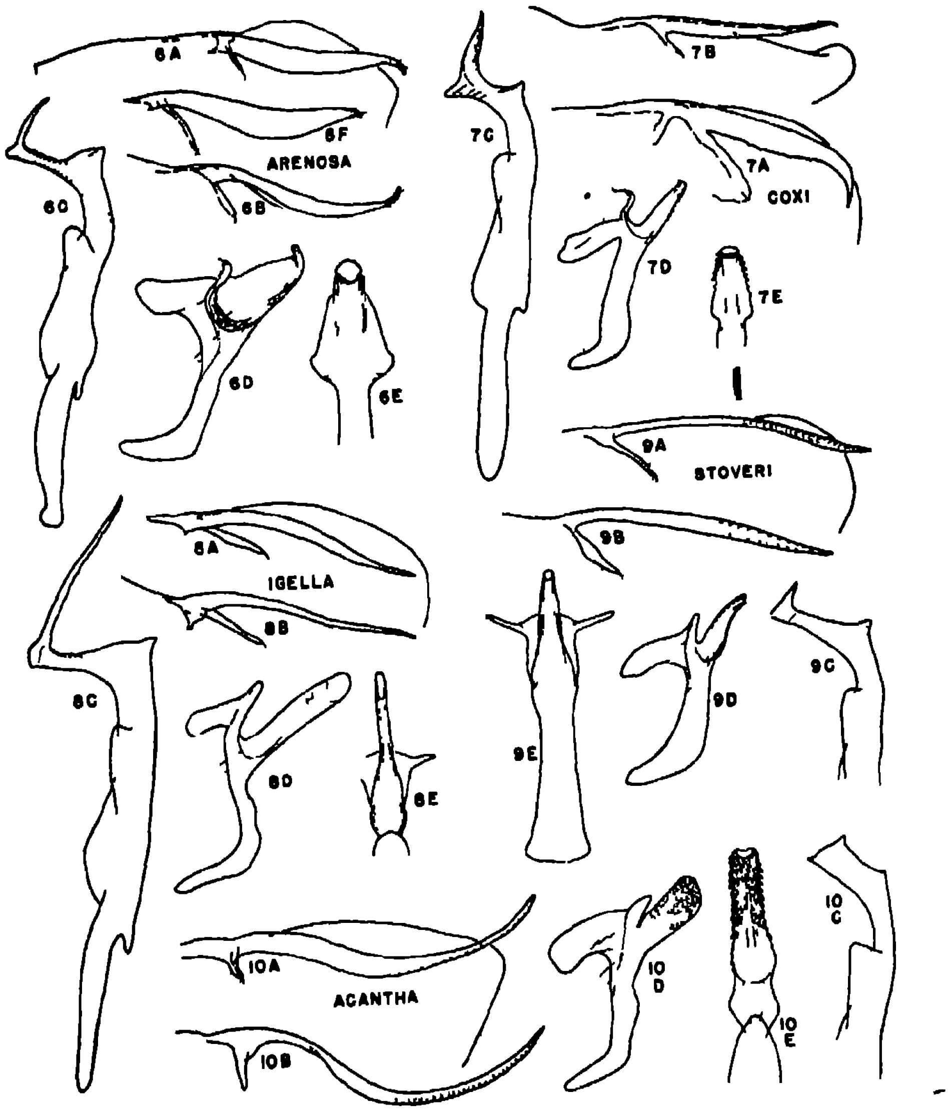
The curious pygofer hook of this species is unlike that of any other known species. The short, wide phalicata indicates a close relationship with *aesculi* Beamer and *spala* n sp , but in these two the pygofer hook is different



ILLUSTRATIONS

In the plates accompanying this article all the figures of a species are magnified to the same scale except for some of the aedeagus, which are 1 5 times the others Those at a higher magnification are figs 1*D*, 1*E*, 2*D*, 2*E*, 4*E* 6*D* 6*E*, 9*E*, and 10*F* The view of the aedeagus shown in all *E* drawings is roughly posterio-ventral, and is the aspect at right angles to the long axis of the phalicata alone

Male—Length 2 8 mm Ground color pale straw color markings on head and pronotum indistinct elytra with markings similar to preceding species but those which are orange and pink in that species are pale yellow in this Genitalia as in fig 2 Pygofer hook elongate surpassing apex of pygofer the base slender and curved the apex cleft to form a long slender dorsal arm and a shorter curved ventral arm both serrate with a few sharp projections the dorsal aspect is markedly sinuate and the entire apical portion is thin and foliaceous Style with foot of moderate size heel large and triangular anterior point inconspicuous and posterior point slender slightly



FIGS 1 10 Male genitalia of *Erythroneura* *A* pygofer hook lateral aspect *B* same dorsal aspect *C* style drawn at right angles to large expanse of foot *D* aedeagus lateral aspect *F* aedeagus or phalicata posterio ventral aspect in figs 3*E* 5*E* 8*E* and 9*E* showing also the lateral expansion of the socket protruding from behind the phalicata *F* pygofer hook dorso lateral aspect sinuate and longer than the length of the foot Aedeagus with phalicata situated near dorsal margin phalicata very short fairly deep and very wide with sharp lateral projections on the main portion toward apex bearing laterally a wide smooth edged flange extending almost the entire length of the phalicata

Holotype male Rocky Branch Clark Co Ill Sept 14 1949 on *Corylus americana* Stannard and Ross (INHS)

Erythroneura quercalbae n sp

This is a close relative of *mira* Beamer differing from it in the U shaped cleft of the pygofer hook and the forceps like position of the two arms

Male—Length 3 mm Ground color whitish cream markings on head and pronotum indistinct elytra with several pale yellow marks in basal portion beyond this with a few thin diagonal reddish marks and with a reddish border along the apical crossveins and with a black mark in the base of cell M_4 Genitalia as in fig 3 Pygofer hook with both lateral and dorsal aspects slightly curved the apical third cleft to form two arms which curve toward each other at apex the dorsal arm the longer both arms and the basal portion of the hook slender Style with foot oblique the heel small and sharp the anterior point minute but angulate and the posterior point represented by a short sharp angulation Aedeagus with phalicata situated just above the middle phalicata long and fairly deep the apex almost angulate the ventral aspect narrow and parallel sided the apical portion with sparse imbrications

Female—Similar in size shape and color to male

Holotype male Elkmont Tenn Gt Smoky Mts National Park Sept 1 1948 on *Quercus alba* Ross and Stannard (INHS) Allotype female same data Paratypes same data 15♂ 12♀ Kickapoo State Park Ill July 28 1948 on *Quercus alba* Sanderson and Becker (INHS) Paratypes in INHS and collection of D M DeLong

Erythroneura spala n. sp

This species is closely related to *bifida* Beamer from which it differs in the swollen and upcurved lateral aspect of the pygofer hook

Male—Length 2 8 mm Ground color whitish head and pronotum with only indistinct markings elytra with black spot in base of cell M_4 and with indistinct yellow markings shaped and situated as in *mellis* Genitalia as in fig 4 Pygofer hook thin and foliaceous the lateral aspect curved first down then up the base slender the middle portion gracefully expanded the apex cleft to form a pair of tapering sharp tipped arms separated at base by a U shaped outline Style slightly oblique the heel fairly large and angular the anterior point small and rounded and the posterior point slender almost straight and longer than the foot Aedeagus with phalicata situated very close to its dorsal point phalicata short shallow but wide and bearing a wide flange with serrate edges

Holotype male Rocky Branch Clark Co Ill Sept 14 1949 on *Fagus grandifolia* Stannard and Ross (INHS) Paratypes Rocky Branch Cr Oliver Ill April 22 1949 Stannard and Ross 1♂ (INHS) Marshall Ill April 22 1949 Stannard and Ross (INHS and coll D M DeLong)

Erythroneura tenuilla n sp

In general characteristics this species approaches *manus* Beamer but differs in the shape of the aedeagus and the less sinuate pygofer hook

Male—Length 2 9 mm Ground color whitish elytra with black spot in base of cell M_4 reddish border along apical crossveins and orange spots as follows an anchor mark and apical mark on clavus and three sinuate marks on corium Genitalia as in fig 5 Pygofer hook with lateral aspect sinuate dorsal aspect slightly so fairly robust gradually expanded toward apex the latter incised to form dorsal and ventral angles which are slightly serrate with a few sharp small points Style with foot oblique heel sharp but not large anterior point blunt posterior point minute but finger like Aedeagus with phalicata situated at dorsal point the socket profile sinuate and the phalicata curving slightly down from it then up phalicata fairly deep its apex rounded its ventral aspect wide at base and tapering to a fairly narrow apex its apex and sides with numerous spiculations

Holotype male Elkmont Tenn Gt Smoky Mts National Park Sept 1 1948 on *Quercus alba* Ross and Stannard (INHS) Allotype female same data Paratypes Marshall Ill April 22 1949 in woods Ross and Stannard 2 ♀ (INHS and coll D M DeLong)

Erythroneura arenosa n sp

This species is a close relative of *marra* Beamer differing in the wide pygofer hook unexpanded apex of phalicata and small heel

Male—Length 2 8 mm Ground color whitish pattern similar to the preceding species but with the markings pale yellow except for the black spot in cell M_4 Genitalia as in fig 6 Pygofer hook foliaceous and moderately long extending to tip of pygofer slightly sinuate in lateral view curving ventrad at extreme tip it is seen at its widest from dorso lateral view fig 6*F* when it appears markedly fusiform Style with foot slightly oblique heel sharp ball of heel with a convex flange instep narrow anterior point short and round posterior point slender sharp curved slightly toward heel and a little longer than half length of foot Aedeagus with phalicata angling only slightly from socket and its dorsal margin almost contiguous with the dorsal point of the socket phalicata deep narrowing toward apex apex upturned to form a small flange ventral aspect of phalicata with main body narrow and parallel sided each side with a lateral flange which is wide at base and tapers into the body just before apex

Holotype male Thornton Ill Sept 7 1949 on *Corylus americana* Ross and Stannard (INHS)

Erythroneura coxi n sp

Although key characters indicate a proximity of this species to *continua* Knull and Auten it does not seem closely related to any known species From *continua* it may be separated by the bladelike pygofer hook and less angular posterior point

Male—Length 2 7 mm Ground color white with irregular pinkish spots on head thorax and elytra these are remarkably similar to the arrangement found in ***maculata*** (Gillette) Genitalia as in fig 7 Pygofer hook thin and bladelike angling slightly ventrad its apex curved sharply ventrad and ending just within the outline of the pygofer lower margin with small well spaced serrations basal rod unusually large Style with foot almost at a right angle with long axis of style heel small and sharp anterior point blunt but fairly long posterior point wide at base tapering to sharp apex slightly sinuate inner margin concave and as long as foot Aedeagus with phalicata fairly close to dorsal point and angles only slightly from socket phalicata shallow straight the tip with a slight dorsal point the ventral aspect fairly narrow with a wide flange down each side serrate on apical half

Female—Size shape and color as for male

Holotype male North East Pa Oct 14 1949 on purple raspberry (*Rubus* sp) J A Cox (coll D M DeLong) Allotype female same data Paratypes same data 66 ♂ ♀ same data but Sept 26 14 ♀ ♀ (coll D M DeLong and INHS) This seems to be the first definite host record of an *Erythroneura* from *Rubus*

Erythroneura igella n sp

The large foot and extremely long posterior point of the style place this species at once in the ***mirifica penevica paria*** complex From these it differs in the longer pygofer hook and the shallower phalicata

Male—Length 2 8 mm Ground color whitish black spot in base of cell M_4 otherwise markings very pale and indistinct Genitalia as in fig 8 Pygofer hook curved downward slightly sinuate not quite attaining edge of pygofer of moderate width at base and tapering gradually to a thin apex Style with large foot set at about a right angle with axis of style heel small and sharp anterior point scarcely differentiated posterior point slender nearly straight and exceedingly long at least one and a half times length of foot Aedeagus with phalicata set at a sharp angle with socket and situated just above midpoint phalicata long shallow and parallel sided its ventral aspect narrow slightly widened at base and with a small flange at each side on basal half the apical half of the structure with a few scattered imbrications

Holotype male Belle Smith Springs Ill July 16 1948 on oak Mills and Ross (INHS) Golconda Ill July 23 1947 on *Quercus imbricaria* Sanderson and Stannard (INHS)

Erythroneura stoveri n sp

The short posterior point of the foot and the elongate nearly straight pygofer hook place this species in the vicinity of *campora* Robinson but *stoveri* may be readily distinguished from this and related species by the curious beaklike phalicata

Male—Length 2 7 mm Ground color white head with thin pink diamond mark pronotum with lateral spots and mesal U spot pinkish elytra with black spot in base of cell M_4 and pinkish marks as follows clavus with a middle square mark and an apical mark corium with scattered marks forming an indefinite and disconnected zigzag and a border around the apical crossveins Genitalia as in fig 9 Pygofer hook elongate extending slightly beyond pygofer lateral aspect slightly sinuate slender of nearly equal thickness throughout and pointed at apex dorsal aspect slightly fusiform and tapering more suddenly toward apex Style with slightly oblique foot heel small and projecting anterior point only a blunt angulation posterior point sharp only slightly longer than depth of instep instep long and slightly but gently concave Aedeagus with phalicata set near dorsal point curving out only slightly from socket phalicata sinuate widest at base and tapering to a spoutlike apex with narrow lateral flanges on basal half and very minute serrations toward apex

Holotype male Rocky Branch Cr Oliver Ill April 22 1949 Ross and Stannard (INHS) Paratypes same data 5♂ (INHS and coll D M DeLong)

Erythroneura acantha n sp

This species is most closely related to *lenta* Beamer differing in the tapering pygofer hook and shape of phalicata

Male—Length 2 9 mm Ground color white markings on head and pronotum indistinct on elytra of usual type but pale yellow and also indistinct Genitalia as in fig 10 Pygofer hook very long extending beyond pygofer lateral aspect slightly sinuate and curving dorsad at apex the basal portion fairly deep the apical half slender dorsal aspect very sinuate and appearing to have a slender base Style with foot oblique heel anterior point and posterior point each represented by a small sharp angulation foot in general short and deep with a nearly straight instep Aedeagus with phalicata situated near dorsal point and angling markedly from socket phalicata of moderate length lateral aspect slightly clavate ventral aspect stout and parallel sided except for a slight enlargement at base almost the entire phalicata beset with sharp spines

Holotype, male Fairfield Ill July 14 1948 on *Carya ovata* Mills and Ross (INHS) Paratypes Rocky Branch Cr Oliver Ill April 22 1949 Ross and Stannard ♂ (INHS) Edgerwood Ill July 23 1947 on *Quercus imbricaria* Sanderson and Stannard (coll D M DeLong)

DID YOU KNOW?

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MINERAL RESOURCES RESEARCH AT THE ENGINEERING EXPERIMENT STATION OF THE OHIO STATE UNIVERSITY

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The Engineering Experiment Station of The Ohio State University was established by legislative act in 1913 It is affiliated with the College of Engineering and operated as a part of that division of the University As stated in the law, "The duties of the Engineering Experiment Station shall be to make technical investigations and to supply engineering data which will tend to increase the efficiency and safety of the manufacturing mineral transportation and other engineering and industrial enterprises of the state and to promote the conservation and utilization of its resources" Any of the state agencies may seek assistance from the Station, the expense of the research being borne in full or in part by the petitioning agency, according to the judgment of the Engineering Experiment Station Advisory Council Citizens of Ohio, business enterprises, etc, may also seek such assistance, subject to certain specifications and contractural agreements

Studies of Ohio's mineral resources are a very important function of the Engineering Experiment Station Because of the importance of this work and the need for better integration of effort, a special project was established in 1946 One of the duties of the supervisor of this project is to act as liaison between the Engineering Experiment Station, industry and other state and federal agencies As a result of many technical investigations of Ohio's mineral resources certain facts and trends have been revealed that may be of interest and assistance to the geologists of the state These will be considered under each of the major lines of interest of the Engineering Experiment Station

FUELS RESEARCH

As a result of increased general interest in synthetic fuels many low-temperature carbonization tests of coals and shales have been made in recent years It has been found that the oil yield from Ohio coals, by this method, compares favorably with yields from coals of other states In 1948, the Geological Survey of Ohio sampled several coals and carbonaceous shales These samples were analyzed at the Engineering Experiment Station and a bulletin summarizing the data is in preparation[1]

Another phase of the synthetic fuel study has been to investigate the Ohio shale as a source of oil Analyses of sample suites taken through the entire thickness of the formation show a general three-fold division of the unit in southern Ohio The upper 80 to 90 feet are the richest, yielding from about 5 to 14 gallons of oil per ton The middle portion gives the lowest assays, 0 to 4 gallons per ton and the lowermost portion gives somewhat intermediate oil yields These facts are consistent with the three-fold division of the Ohio shale noted in the northern part of the state

From analyses to date it may be stated that the Ohio shale is not suitable for oil production ***under present economic conditions*** Should the economic factors undergo a distinct change, or should sufficiently valuable by-product uses be discovered, certain areas of this large deposit of low-grade material may be amenable to exploitation The survey of this resource is not complete but sufficient data are available to indicate that further investigation can be made somewhat incidental to other research problems

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[1] Bowen, C H Smith, W H and Krumin, P O "Further Studies of Ohio Coals and Shales" Ohio State University Engineering Experiment Station, *Bull 148*

Coal Beneficiation

Other fuels research includes a coal beneficiation project whose aim is to improve the quality of Ohio coals for the general fuel market and for use in the production of synthetic fuels This coal beneficiation project is being done in cooperation with the Division of Geological Survey The Meigs Creek, or number 9 seam, is the coal being investigated at present, inasmuch as it constitutes the largest undeveloped reserve of coal in Ohio The research will attempt to determine the nature and mode of occurrence of the sulphur and ash, and to determine what processing will be required to economically remove those impurities

The beneficiation program may have more far reaching results than those expressed in our immediate aims No Ohio coal is used by the coking industry at present, but when the low sulphur coking coals of the Appalachian Field are exhausted certain of Ohio's coals may be beneficiated to the extent that they too will be used in this industry Demorest[1] found that the numbers 6, 7 and 8 seams would coke, especially if cleaned and then blended with low-volatile coal

Underground Gasification

A rather new development in the utilization of solid fuels is the underground gasification of coal In this process the fuel values are extracted as a gas without recourse to customary mining techniques The coal seam is set on fire and the gases extracted by means of drill holes and/or simple mine entries Since the strata overlying the coal form the retort, the character and thickness of these strata are of prime importance According to the rather incomplete data available at present the following generalizations may be made

1 The cover should be quite thick in order that it may absorb any subsidence

2 A thick shale series seems desirable, first, because through-going joints are not so common, and secondly, because in subsiding the broken shale rapidly increases in volume, filling the void and hence does not tend to break to the surface

3 Bloating and swelling of the roof rock under the action of heat is desirable, such bloating tendencies are often present in carbonaceous, pyritic and micaceous shales The expansion of the roof rock tends to fill the burned-out area and crowd the air blast against the fire face Limestone is undesirable as a roof rock because the carbonate decomposes, creating a still larger void and the carbon dioxide given off dilutes the effluent gases

CERAMICS RESEARCH

A great deal of the research at the Station has been in the field of ceramics In structural clay products, for instance, the aim has been to find, test and develop standards for better raw materials, another aim is to develop better blending methods so that these raw materials will produce a ware having high strength, a long firing range and low porosity It has been found that many of Ohio's shale units are admirably suited for such wares In fact, a request was recently received from a North Carolina ceramic producer for sources of such Ohio shales so that he could purchase several carloads a week for blending with local material

Several of the shales in the Coal Measurers are found to possess very desirable qualities. Of these the Clarion shale, of Hocking and Perry counties, is an outstanding example Two Conemaugh shales, the Buffalo and Brush Creek, have been found suitable at least in places The Mississippian Bedford shale is also widely used for brick and tile, and some of the shales of the Cuyahoga formation are utilised locally

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[1] Demorest, D J "Carbonization of Ohio Coals' Ohio State University Engineering Experiment Station, *Bull 46*, 1928

A shale showing the following properties will generally warrant testing for structural clay products

1 A moderate amount of free silica

2 Low carbon content

3 Fairly high iron content, but disseminated and in the oxide form Pyrite is deleterious

4 Soft and friable, which is a fair indication of good workability

5 No marked efflorescence at the outcrop which indicates the presence of harmful sulphur, sulphates and other soluble salts

6 Presence of small quantities of finely divided (sericitic) mica

7 Low lime and/or magnesium content, these constituents tend to shorten the firing range and to act as a bleach

Lightweight Aggregates

Several Ohio materials are suitable for the manufacture of lightweight aggregates Among the units tested and found good are the Ohio shale, Minford Silts, Bedford shale and several of the coal formation shales Lightweight aggregate is essentially an artificial, vesicular lava The raw material is heated rapidly so that the mass is viscous (pyroplastic) at the time that certain minerals decompose with the evolution of gas The gas bubbles are entrapped in the somewhat viscous mass which is cooled before the gas completely escapes Not much gas is required and, at present, it is believed that carbon and pyrite are the chief gas sources Finely divided mica, in moderate quantities aids in fluxing and the water inherent in the mica molecule may aid in the blowing action

Other Ceramic Research

The Minford Silt has been found to be a good glazing material if blended with some fluxing agent, by itself it is too refractory

A profitable line of future investigation would be the beneficiation of some of our more plastic clays by the flotation process There is a distinct possibility that clays such as the Clarion of Vinton County and the Lawrence of Lawrence County could be made into good substitutes for ball clays in the manufacture of whiteware

FOUNDRY SAND

The Experiment Station and the Ohio Division of Geological Survey are sponsoring an investigation of Ohio foundry sands, although the project is far from complete, certain facts and trends are now known

So-called synthetic sand and clay mixtures are replacing naturally bonded molding sands, especially in the large foundries This trend will work to the disadvantage of certain naturally bonded sand producing areas in the state, such as Gallia, Muskingum, Erie and Ashtabula counties This need not be a total loss inasmuch as Ohio is rather well supplied with sources of clay-free base sands The Sharon, Massillon and Black Hand sandstones are important producers of synthetic sands and are capable of even greater production The Berea sandstone and the dune sands of the old lake beaches can also be treated (washed) to satisfy demands for which present producing units cannot qualify

A second trend in foundry practice may also aid our synthetic sand producers In the past the foundries wanted well-sorted sands, those in which the bulk of the sand was retained on three adjacent sieves, hence sands such as those from the St Peter formation and from the dunes in Michigan commanded a premium market Present foundry practice requires less well-sorted sands in which the bulk of the material is retained on 5 or 7 adjacent sieves Under these specifications the well-sorted sands will loose their premium rating in the industry and Ohio's sands may be more favorably received by the foundry industry

Present research is directed at other traditional foundry specifications some of which work to Ohio s disadvantage The trends seem to indicate that *some* of these specifications are merely traditions and have little basis in scientific fact If and when these traditions are exploded (and it will be a difficult task) Ohio sand producers may be in a better competitive position than they now are

LIMESTONE

In 1948 the Engineering Experiment Station and the Division of Geological Survey co operated in drilling a core hole through the Maxville limestone in Muskingum County This hole was part of a program to explore sources of high calcium limestone in Southern Ohio The hole bottomed in the Vinton shales at 385 feet and showed about 70 feet of Maxville overlying them The analyses indicate the existence of about 26 feet of rather good limestone and nearly the entire thickness is suitable for cement manufacture The basal 8 feet of the Maxville shown in the core is a brecciated dolomitic limestone which with the other lithologic and paleontologic variations noted could form the basis of an interesting geological study As might be surmised from the thickness of the Maxville the overlying Pottsville section was very short

Other investigations in limestone and dolomite include the plotting of all existing quarries and collecting data on the physical and chemical properties of the rock These data may be of some assistance in the correlation of strata and may also assist in noting areal variations in the units involved

This paper has been a summary of *some* of the data available at present The incomplete results of some projects and the contractural nature of others has precluded the making of any further statements at this time However the Station by means of its various publications will make these results available as soon as possible

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THE OHIO JUNIOR ACADEMY OF SCIENCE

FREDERICK H KRECKER

Department of Zoology Ohio University
Athens Ohio

As every one connected with the Ohio Academy of Science knows its officers and Council have been placing special emphasis upon making the Academy an organization which will serve all the scientific interests of the state With this end in view one of the projects recently undertaken by the Academy has been the organization of a Junior Academy of Science Since most members of the Academy are probably not familiar with the scope of the Junior Academy s activities an outline of what it is intended to accomplish may be of interest

Those who have been responsible for developing the Junior Academy have proceeded on the principle that the chief purpose in establishing such an organization is to aid in discovering and rewarding scientific ability among high school students It has also been assumed that discovery and initial stimulation of talent among these students is in the hands of high school science teachers that reward and encouragement toward continued effort is the function of the Ohio Academy of Science

Past experience in the form of an earlier attempt to develop a Junior Academy revealed that an elaborate organization involving clubs student officers a student council and all the other machinery made use of by their elders is more of a distraction to the students and a burden to their instructors than a help Consequently the present plans do not call for any organization among the high school students themselves Their role is solely that of students interested in science who develop projects under the guidance of their instructors In line with this our plan calls for the students to be made junior members of the Ohio Academy of Science and for the various activities of the junior members of the Academy to be directed by a Junior Academy Council made up of college and high school science instructors If conditions in individual instances favor some form of local organization such as a science club it may be established or advantage may be taken of an existing club but such action is a purely local measure The Junior Academy as such takes no part in it

High school science instructors and others whose primary interest lies in the development of science at the secondary school level instead of belonging to a Junior Academy of Science become members of the Ohio Academy of Science A separate section the Science Education Section has been organized especially for this group of members although they can belong instead to another section of the Academy if they care to The purpose of the Science Education section is two fold In the first place it serves as a means of bridging the gap between science teachers on the high school level and those on the college level It also affords an opportunity for high school teachers of science throughout the state to exchange their views Groups of teachers are usually organized on a strictly regional basis and so provide opportunity for an exchange of views on a regional basis only There is ordinarily no opportunity for an exchange of views on a statewide basis This opportunity the Ohio Academy of Science hopes to provide

From all of this it can be seen that there is in reality no Junior Academy in the usual sense of the word Instead what we actually have is a Junior Division of the Ohio Academy of Science for high school students and a Science Education Section of the Academy for high school teachers By these two devices the Ohio Academy is taking one more step toward welding the science minded persons of the state into a single unit one that can truly be considered an Ohio Academy of Science

The operation of the Junior Academy plan is as follows The state has been divided into six districts, each centering about a college or university Five of the regions have as a center one of the five state universities The sixth region has Muskingum College as its center Each year high school students interested in science who have developed some special project of a scientific character, exhibit the results of their efforts at the central institution in their district on what is termed a Science Day This day is usually set sometime in April. It is supposed to come not later than two weeks before the annual meeting of the Ohio Academy of Science Arrangements for the district Science Day are made by a committee of high school teachers with the cooperation of a representative from the science staff of the regional institution Projects exhibited are expected to illustrate some phase of the following major fields of science Botany, Chemistry, Geology, Physics, Zoology, Mathematics or applied subdivisions not readily limited to any one field, such as photography, conservation, agriculture, health consumer science The exhibits may be in the form of collections, experiments, apparatus or papers, although papers are not encouraged All exhibits are intended to represent something the student has done in addition to class work Each student entrant pays a fee of 50 cents This fee together with the fact that he has presented an exhibit makes him a Junior Member of the Ohio Academy of Science He has no voting privileges and can hold no office Projects are judged by members of the science staff of the district institution working in pairs Awards made are rated as satisfactory, good, excellent, superior Certificates attesting the appropriate awards are given to exhibitors

Winners of a superior award in the districts are entitled to enter their exhibits in a statewide Academy of Science Day held in connection with the annual meeting of the Ohio Academy of Science Exhibitors at an Academy Science Day must belong to one of the four upper high school grades At district exhibits pupils from the seventh and eighth grades may be admitted at the discretion of the district committee There is no fee for entering the Academy exhibit Exhibits are judged by teams made up of one University and one high school science instructor Awards are the same as for the district, except that no grade of satisfactory is given A certificate bearing the seal of the Ohio Academy of Science is given each exhibitor In addition, scholarships are available in the state universities to outstanding exhibitors In order to be eligible for a scholarship the student must have received a superior award in the state Science Day, must have satisfactorily passed a Science Achievement Test supervised by the Academy, and must have a B average in high school

The judging of exhibits upon which awards are based involves a personal interview with the student as well as an inspection of his entry The interview is directed toward discovering the student's understanding of his particular project, the field with which it is allied, as well as his interests and personality Quality of the exhibit and an intelligent grasp of its significance weigh heavily in making a decision Decisions of the judges in the form of certificates of award are announced at an Awards Meeting at which time the certificates are handed to the students At the district meetings a representative of the district institution usually extends greetings and a member of the science staff speaks briefly on some scientific topic At the Academy Meeting the president of the Academy or his representative extends the greetings of the Academy and speaks informally to the students and their instructors and friends

Since accomplishment among high school students reflects the influence of their high school instructors, an attempt has been made to recognize the important role played by the high school teachers Special recognition is each year given to one teacher from each district who has shown outstanding success in developing an interest in science among high school students The award is a paid-up membership for one year in the American Association for the Advancement of Science with a choice of either Science or Scientific Monthly The selected teachers are invited to be guests of the Ohio Academy at its annual dinner A letter, calling his attention to the fact that one of his teachers has been selected for special recognition by the Ohio Academy of Science, is sent to the teacher's superintendent and he is congratulated for having such a teacher on his staff

The Junior Academy Council, which is the executive body for the Junior Academy activities, is composed of the chairman of the Science Education Section, its membership committeeman, a college instructor and a high school instructor from each district, the editor of the Newsletter, and the executive secretary of the Junior Academy The district institution representative, the editor and the secretary serve for a number of years High school district representatives serve one year, the Science Education Section representatives serve two years The Council functions under the authority of the Ohio Academy Within the limits of this authority it makes all regulations for the Junior Academy

By way of stimulating interest and keeping various high school science teachers informed of activities, a Newsletter is issued four times a year and sent without charge to all high school science teachers At least one issue per year is sent to superintendents and principals

The reaction of both students and teachers to this Junior Academy plan has been most encouraging during the two years it has been in operation on a statewide basis The first Academy Science Day was held in connection with the Denison University Meeting of the Academy in 1949 On that occasion 78 high school students entered exhibits, each of them having previously been awarded a superior rating in a district Science Day exhibit The total number of entrants in the district exhibits held that year was about 600 The Science Day held in connection with the 1950 meeting of the Academy at Capital University had 130 entrants and the district Science Days of that year had a total entry list of 759 The quality of exhibits in both years was remarkably high In the past two years district Science Days were held at the five state universities only, but this year Muskingum College will be added to the list

In this connection it should be said that the state universities were selected as initial Science Day centers because they are so placed geographically as to lend themselves to a well balanced division of the state into districts It was felt that if the Junior Academy took root at these centers, additional colleges or universities could be selected as growth occurred Growth has occurred and it is for this reason that Muskingum College was asked to serve as an additional center As rapidly as conditions make it necessary other institutions will be selected and it is hoped that those chosen will find it possible to serve

An encouraging aspect of the Junior Academy plan is the generous support which each of the five state universities has given to the scholarship feature of the plan Each university has set aside a certain number of tuition scholarships The understanding between the universities and the Academy is that within the limits of the quota each university has set, each one will stand ready to give scholarships to those students who have been awarded a scholarship privilege by the Academy This scholarship feature of the Junior Academy activities is one in which all of the colleges and universities of the state can immediately take part The plan as just outlined is quite simple and the Junior Academy Council is anxious to have as many as possible of the colleges and universities join those now associated with the plan

Just a word regarding finances As mentioned before, each student who enters a district exhibit pays a fee of fifty cents Part of this is retained for district expense and part is used for statewide expenses The district institutions also contribute toward expenses incurred in the district The Academy of Science appropriates funds to aid in defraying general expenses. The Newsletter is the largest item of general expense Its printing is paid out of the Academy funds.

Mailing costs of the Newsletter have been assumed by the districts The districts also defray the costs of their Science Days Included is a complimentary luncheon for teachers and a variety of incidental expenses The general fund for the state in addition to paying for the Newsletter covers the cost of printing certificates of award, providing ribbons and seals used on the certificates as well as various other incidental expenses connected with the state as a whole The general fund also pays the membership fees in the American Association for the select group of teachers and their Academy dinner charges

Finally a word of deep appreciation is due the officials of the respective institutions which serve as district centers for the generous manner in which they have supported the Junior Academy both by helping to defray local expenses and by showing a real personal interest in the undertaking A similar word of great appreciation is of course due the officials and the Council of the Ohio Academy of Science for their whole hearted interest in the Junior Academy an interest expressed both by generous financial support and by personal efforts

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